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June 22, 1959

Aviation Week

Including Space Technology

A MCGRAW-HILL PUBLICATION



Next Decade in Space

Special Report on NASA Programs

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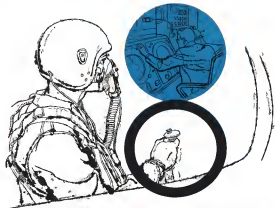
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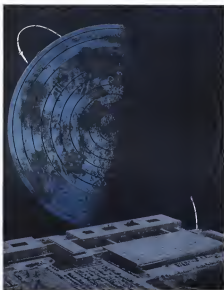
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AVIATION CALENDAR

(Continued from page 5)

- Aug. 24-26—Gas Dynamics Symposium, American Rocket Society, Macdonald University, Evanston, Ill.
- Aug. 24-25—Institute of the Aeronautical Sciences, National Specialists Meeting, a symposium on subsonic aerodynamics, (closed), Los Angeles, Calif.
- Aug. 27-28—International Commemorative Scientific Symposium, Church House, Westminster, London, England.
- Aug. 31 Sept. 2—Annual Navy Navy-Navy Western Program (NWP), Symposium and Address, Seaside, Santa Helen Hotel, Del Mar, Calif.
- Aug. 31 Sept. 1-2—19th Annual Congress International Astronautical Federation, Clermont Hotel, Westminster, London.
- Sept. 1-2—Conference on physical chemistry in aerodynamics and space flight, University of Pennsylvania, Philadelphia. 75 sponsors. Air Force Office of Scientific Research and General Electric Co.'s Missile and Space Vehicle Dept.
- Sept. 2-4-19th Aerospace Engineering Conference, University of California, Berkeley, Calif.
- Sept. 4-6—National Conventions and Aerospace Symposium, Air Force Armory, Baltimore, Md., Natick, Mass., Pa.
- Sept. 7-11-1970 Farnborough Flying Display and Exhibition, Society of British Aircraft Constructors, Farnborough, Eng.
- Sept. 7-11—South Midwestern Conference on Fluid and Solid Mechanics, University of Texas, Austin, Tex. Sponsors: AFOSR/Department of Aeronautical Sciences, Office of Naval Research, National Science Foundation.
- Sept. 16-17—Western Regional Meeting as President on Research and Engineering, Institute of the Aeronautical Sciences, Los Angeles, Calif.
- Sept. 18-25—14th Annual Conference and Exhibit, Astronautical Society of America, Chicago, Northwestern, Chicago, Ill.
- Sept. 21-22—1970th Annual Meeting, School of Engineering Science, no attendance in Soviet, Sverdlovsk Hotel, Sverdlovsk, U.S.S.R.
- Sept. 23-24—Space and Operations Symposium, Science Corp., Malibu, N. J.
- Sept. 24-25—Solid Rocket Conference, American Rocket Society, Princeton University, Princeton, N. J.
- Sept. 24-26—19th Annual Symposium on Telemetering, Circ. Automation and Whitehead Hotel, San Francisco, Calif. Sponsors: Institute of Radio Engineers, Professional Group in Space Electronics & Telemetry.
- Oct. 5-7—Scientific Anglo-American American Post Conference, American Astronautical Society, Pearl Hotel, New York.
- Oct. 5-10—National Astronautical Meeting, Society of Automotive Engineers, the Automobile Club, Los Angeles, Calif.
- Oct. 6-11-12th Annual Meeting, National Business Aircraft Assn., Hotel Llewellyn Inn, Minneapolis, Minn.
- Oct. 8-10—International Symposium on High Temperature Technology, Institute for Systems Studies, Maritime Research, CSM, Space Research Research Institute.
- Oct. 12-15—11th General Convention of the International Air Transport Association, Tokyo, Japan.



Space-age research gets a new headquarters—One of the largest and best equipped research facilities in the nation is the new 38-million-dollar Avco Research Center at Woburn, Massachusetts. Here, research and development in space-age technology is already being conducted in work ranging from missile re-entry to satellite design. Here work such as air—and equally important work at the nearby Avco Research Laboratory—will come further contributions to national security and the conquest of space.

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2. Large, quick-opening doors for the fuselage bays, which swing up to give waist-level access to all major systems.
3. Quick, complete access to cockpit consoles and contained equipment.
4. Related consoles and systems on the same side of the fuselage to give short-run, snap-in-trace wiring.
5. Horizontal stabilizer, elevators, ailerons, and tail interchangable.
6. Service-proven, off-the-shelf components wherever possible.

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So the T2J is once back on the flight line, ready for the job it was designed to do—outpace better-trained operational pilots.

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T2J's NEW! FUSIBLE ARMED WEAPON SYSTEM

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Continuing this pioneer tradition, the Bell X-14 which rises and lands vertically in a conventional horizontal attitude has demonstrated that the minimum take-off requirements of helicopters can be combined successfully with high-speed jet performance. An operational military airplane embodying this Bell-developed VTOL concept is now in advanced stages of development.

Ticker, however, BELL means much more than AIRCRAFT!

In the field of Space Flight, Bell engineers are making many contributions to study progress toward man's conquest of that incredible wilderness area beyond the earth's atmosphere.

In defense, Bell has developed an all-weather automatic landing system which brings aircraft in to touchdown as fast as carrier without pilot control. In tests it has landed the Boeing 707, the B-47 and Republic F-105. Hyperion II, a new concept in advanced inertial navigation—and many other important systems, sub systems and components also are under development.

In Rocketry, Bell has completed the first large-scale rocket thrust chamber firing using the efficient in chemical oxidizers, elemental liquid oxygen. Bell has also played an important role in the development and production of propulsion systems for many of our present arsenal of missiles, as well as in the future.

Bell's capabilities extend not only research and development but efficient and economical production as well. Perhaps Bell can serve you. Your inquiry will receive prompt attention.

Niagara Frontier Division



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Shown Above: Oil Cooler—Another Device Product of General Motors Research



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Over 600 T-38 Talons, designed as possible with the new 500W electronic jet engine by General Electric, are being produced by Northrop. Chatham power supplies are selected for the T-38 Talon jet engine. The T-38 Talon jet engine is a 500W electronic jet engine. The T-38 Talon jet engine is a 500W electronic jet engine. The T-38 Talon jet engine is a 500W electronic jet engine.



Chatham power supplies selected for NORTHROP space-age jet fighter!

Northrop, to secure the finest quality materials and components for its new T-38 jet engine, selected Chatham power supplies for the T-38 jet engine. Chatham power supplies are selected for the T-38 jet engine. Chatham power supplies are selected for the T-38 jet engine.

Chatham power supplies come highly recommended for use in military systems. Performance of Chatham units is second to none. Chatham power supplies are selected for the T-38 jet engine. Chatham power supplies are selected for the T-38 jet engine.

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You can join Northrop and the many other airborne manufacturers that draw power from the latest Chatham power supplies. Chatham power supplies are selected for the T-38 jet engine. Chatham power supplies are selected for the T-38 jet engine.

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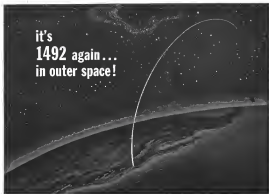
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GPL data handling

equipment for the Federal Aviation Agency



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The FAU data processing system is just one of a number of software and ground-based programs reflecting GPS's capabilities in the data handling field. These programs are supported by GPS's proven ability to understand the customer's problem and capacity to anticipate future requirements. The GPS organization is systems oriented,⁴ offers complete capabilities ranging from research, engineering and manufacturing to customer service.

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- ADC, BASE, SAC
- MILITARY OPERATIONS
- OFFICE
- MILITARY TOWERS
- MILITARY - CIVIL RAPCON
- WEATHER BUREAU
- AIRLINE DISPATCH
- (RADIOS) OFFICE
- CAS TOWERS
- AIR TRAFFIC
- COMMUNICATIONS
- STATIONS (ARTCC)
- ADJACENT AREAS

[illegible]

Key words: *Salmonella*; *Shigella*; *Shigella* spp.; *Shigella* spp.; *Shigella* spp.



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DOI: 10.1002/for

available (19,20). Testing is recommended for men

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STUDY NO. 03 HAZARD SERVICE CASE 15



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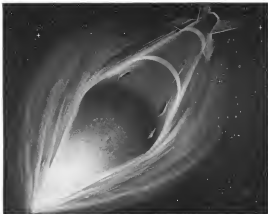
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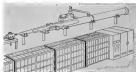
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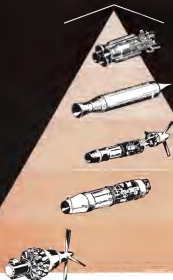
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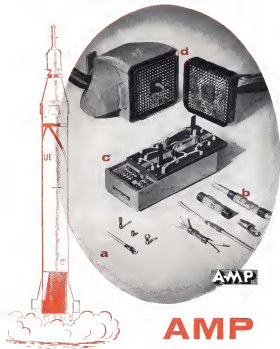


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- up to 1200°F operating temperature
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- wire size range 22-18 AWG
- inserted into barrel for maximum tensile strength

b CERTISEAL AND Ampli-MYL SPICES

- stranded wire size range 22-22 AWG
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- universal or shielded systems
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- contacts have star based accommodation for taper pins to provide reliable solderless lead terminations

d 20D CONTACT CABLE CONNECTOR FOR CRITICAL MULTIPLE WIRING APPLICATIONS

- voltage rating, 1,000 volts A.C., 18 MVA, current rating in excess of three amperes
- connector can be electrically disengaged without mechanical separation
- five indexed positions to permit selective cable entrance
- identical brands and contacts in both halves
- polarized to prevent improper coupling—has numbered cavities to ensure proper circuit identification

Complete information on these four product lines is available on request.

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52 CIRCLE NO. 22 READER SERVICE CARD

Johns-Manville announces new **MIN-KLAD** insulation!



Now Min-Klad insulation is engineered and installed to your design requirements.

Combines the capabilities of asbestos-reinforced plastic with the dramatically low conductivity of **MIN-K** insulation!

Now, Min-Klad insulation may well be the most significant advance ever made in plastic and asbestos insulation.

Developed by Johns-Manville research scientists, Min-Klad is the only product of its kind, a permanent combination of the plastic industry's most effective, high-temperature materials: 1) reinforced plastic and 2) J-M's newly developed Min-K insulation.

Does more than plastic alone

Min-Klad gives the plastic designer all the advantages of high-temperature plastic: Strength, toughness, rigidity! Erosion resistance! High heat capacity! But Min-Klad does more.

It also insulates... and with dramatic effectiveness! Its insulating element is 3-5th Min-K, as compared with thermal conductivity that is actually

lower than the molecular conductivity of air! And this conductivity (already less than half that of the best fibrous insulations) drops still further with altitude. At 10 miles, for example, it is diminished by as much as 40%, with further decrease at greater altitudes.

Wide range of applications

Min-Klad offers the plastic and asbestos designer a rich choice of heat-treated conditions. It may be used for a part that must insulate, yet have the structural advantages of plastic. Where requirements call for a self-sufficient, non-resistant insulating surface... or for a good adhesive bond between Min-K insulation and other surface. Or, it may be used to control high transient

temperatures! For high heat capacity at asbestos-reinforced plastic combined with the low conductivity and heat capacity of Min-K itself is a product that provides superior heat insulation under transient conditions.

Min-Klad is now being tested for approximately two dozen plastic and asbestos designs. Why not investigate this new material for your present thermal requirements? Upon request, we'll be pleased to send you a sample of the material along with detailed technical information. Write Johns-Manville, Box 14, New York 30, New York (Ask, too, for information on Min-K insulation and the new asbestos insulation brochure D-185A.) In Canada, Port City, Ontario.

JOHNS-MANVILLE



CIRCLE NO. 53 READER SERVICE CARD 53

Armco PH 15-7 Mo Stainless Selected for the B-70 Valkyrie and F-108



It's the primary sheet metal for construction of newest air weapon systems being developed and built by Los Angeles Division of North American Aviation, Inc.

The B-70 Valkyrie and the F-108, Mach 3 aircraft designed for 70,000 ft. altitudes, will add powerful long-range weapons to America's air armor. Both the sleekest-view intercontinental bomber and the interceptor being created by North American, in collaboration with a team of major defense firms, are to be constructed primarily of stainless steel.

Because Armco PH 15-7 Mo Stainless maintains its strength at the high temperatures caused by speeds exceeding 3000 mph, it has been specified for the major parts of the airframes.

This special stainless steel, in flat and sheets, will be fabricated into high strength, honeycomb panels for wings, fuselages, and cockpit canopies. It will also be used for other key structural elements of both aircraft.

Selection of Armco PH 15-7 Mo, newest of Armco's widely used family of precipitation-hardening stainless steels, demonstrates the superiority of this high strength, best and corrosion resistant metal. For complete information on the properties and fabrication of Armco PH 15-7 Mo Stainless Steel, write Armco Steel Corporation, 2528 Curtis Street, Middletown, Ohio.

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Completely New...

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WEATHERHEAD



The Weatherhead fuel line system for Boeing's B-52G meets the most stringent requirements in terms of operating characteristics, material properties, light weight and unusually large range of sizes (1 1/2" to 4" I.D.). Approximately 75 different assemblies provide continuous distribution of fuel to the integral wing and fuselage tanks to the eight jet engines. The special hose is necessary in the JP-4 or JP-5 fuels employed, even where it carries ignited fuel.

In developing the entirely new hose assemblies, Weatherhead worked on the specifications with Boeing engineers. Shortly afterward, Weatherhead had established mass production of the full range of qualified assemblies.

This is an example of how Weatherhead smoothly synchronizes its staff research and development, engineering and manufacturing facilities to originate and supply special needs within tight timetables. Whatever your field system requirements, look to Weatherhead for assistance from concept through production.



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meeting such challenges as
-320°F... 1200°F... 40,000 psi

No one at United has shrank a split into the O-ring for a long time! This despite the fact that static sealing requirements for space flight and nuclear power constantly grow tougher and tougher. By combining imaginative engineering with product superiority, United has met a long series of challenges involving metallic O-ring seals. For example, United Metallic O-rings have satisfied requirements on such unusual static seal applications as:

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Wingcase Flaps: 300°F/450 psi
Internal Hydraulic Pressure: 40,000 psi
Nuclear Apparatus: 1300°F/400 psi
Gauges: -320°F/100 psi
Helium: 1200°F/400 psi
Water: 150°F/2100 psi
Vazod Closure: 1000°F/1200 psi
Space Test Chamber: 10 Years 14, Vazod/1-320°F

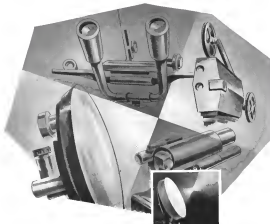
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If you are working on tracking and guidance systems—or any system employing precision optical—durable, lightweight, precision Repli-Kote Mirrors offer you greater design and production freedom. Let us help you make the most of Repli-Kote Mirrors in building a better product at lower cost.

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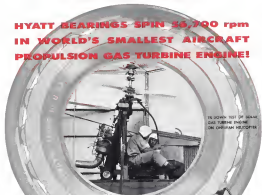
electrical power equipment for aircraft and missiles. They are engineered to meet the strenuous requirements in performance and reliability called for in today's (and tomorrow's) missiles. For more detailed information write to RED BANK DIVISION OF BENDIX AVIATION CORPORATION, RADFORDTOWN, NEW JERSEY.

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continuously senses temperature at 100 or more separate points.

You always know the temperature condition of every point covered by this Fenwal Monitoring System. There's no switching from point to point. With each probe continuously "on duty" it's literally everywhere at once!

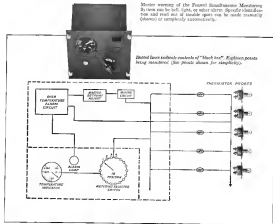
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40 CIRCLE 100, 34 READER SERVICE CARD



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FIRSTS
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MAGNESIUM PRODUCTS



THERMAL PROPERTIES OF LIGHTWEIGHT MAGNESIUM offer advantages to missile men

Most engineers are aware of the advantages available to them when they combine magnesium's light weight with its good mechanical properties at elevated temperatures up to 800°F. There are, however, other advantages such as thermal properties that are less well known. They, too, can be of real value to missile designers. In many cases they will open new areas in design previously considered closed to magnesium.

Let's consider one of these, magnesium's high specific heat and its relationship to missiles. This can mean lower temperatures for given flight conditions. As a result magnesium can be used under very severe flight conditions in short time applications (See Fig. 1.) This permits the use of magnesium in high speed missiles which are exposed to heat protecting atmospheres for only a matter of a few

seconds. With magnesium acting as a heat sink it also results in reducing environmental temperatures for electronic equipment.

Magnesium offers other thermal properties that are of value in missile and missile design. For example, the thermal diffusivity of magnesium-thorium alloys (Thermal conductivity/Specific heat x density) is high and remains fairly constant over a large temperature range. Between 65° and 960°F the thermal diffusivity of these alloys is in the range of 0.57 and 0.15 cm./sec. (2.3 and 2.9 ft./hr.)

For more complete data and for Bulletin 141-637 "Magnesium Alloys for Elevated Temperature Use" Contact your nearest Dow Sales Office or write to: Mr. Howard CHAMBERLAIN, Midland, Michigan, Department 1300/66-22.

- Design a missile with light, strong magnesium alloys.
1. SELECT the thermal or thermal diffusivity of alloy.
 2. USE DESIGN EQUATIONS AND FACTORS for guidance and other calculations.
 3. CORRELATE AND INTERPRET the test data.
 4. ANALYZE AND EXTEND the test data when needed.
5. SELECT THE BEST MATERIAL for high speed missiles. SELECT the thermal diffusivity of alloy, density and weight.



Fig. 1. Magnesium-Thorium alloys show high thermal diffusivity.



Fig. 2. Alloy of 90% magnesium and 10% aluminum shows high thermal diffusivity.

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EDITORIAL

Our National Space Program

It has been just about 21 months since the Soviet Union upstaged the drama of the space age with the successful orbiting of Sputnik I. It has been just about nine months since the United States created the National Aeronautics and Space Administration as the agency charged with organizing and operating a national space exploration and research program. In this special space research note, *Aviation Week* is describing the basic space research program developed by the NASA and the organizational methods and procurement techniques by which it hopes to accomplish its goals during the next decade.

These facts are contained in a special 36-page insert beginning on p. 119 entitled "The Next Decade in Space." It was compiled by a special *Aviation Week* editorial task force headed by Space Technology editor Kurt Clark, Assistant Editor Philip J. Klass and Engineering Editor J. S. Bara, Jr.

NASA faced a formidable task when it was created by legislation during the 85th Congress. At that time the United States had no truly national space program, although several scattered efforts at space exploration, including Vanguard and Explorer had appeared in an uncoordinated fashion. At that time the Soviet race across with the first three Sputniks put heavy pressure on NASA to initiate U.S. prestige in this important race this year.

Three-Fold Task

It is still far too early to expect any major achievements in this new NASA. The task of this agency in this initial nine month period has been three-fold:

• **First**, to organize all of the existing space research and development facilities and programs already existing in the old National Advisory Committee for Aeronautics, the USAF Air Research and Development Command, the Navy's Office of Naval Research and the Army's Jet Propulsion Laboratory and Bellmop Missile Agency into a truly national space exploration program.

• **Second**, to lay the basic research foundation for this program on which the specific development program of the future could be soundly based. NASA has done a remarkable job in authoring a sound, long range scientific research program in the shortest time available. If paired with the man vigor and thought that has gone into its organization this program should yield fruitful results in the decade ahead.

• **Third**, to develop specific short range programs aimed at making the basic, scientifically fruitful probes into space. Two vital programs have already been accepted in this area—Project Mercury to put a manned capsule into orbit and recover it and the space booster program aimed at providing basic power for the space vehicle of the next decade. In both these programs, NASA has made maximum use of the technology and research at early stages by industry, the military service and the scientific community.

In moving rapidly toward these goals, NASA has been aided immeasurably by the strong support afforded by key groups in the Congress. The fact that, of the

House select committee headed by Rep. John McClellan (D-Miss.) in the 85th Congress in *Aviation Week* and the Senate Committee on Aeronautics and Space Sciences headed by Sen. John Stennis (D-Miss.) and his professional staff headed by Vice Libbert. The hearings held by this group earlier this year on the NASA program, long range plans and scientific objectives were an important contribution to both legislative and public understanding of this vital effort. The committee's 675-page report on these hearings published by the Government Printing Office reflects valuable supplementary details in specific areas.

Kurt Clark, NASA administrator, and his deputy, Dr. Hugh L. Dryden, have been extremely careful and deliberate in their discussions before the legislature on the one and timing of the proposed NASA programs. They have pointed out such spectacular achievements as crossing barriers between space.

A sound, constant and fruitful national space exploration program will require considerable investment of money, scientific talent and technical technology. Although the Fiscal 1960 NASA appropriations will be about \$485 million, this is only as much for the large station involved in space technology leadership for the future. As the NASA program expands and gives momentum it will require annual budgets ranging up to \$2.5 billion within the next few years, according to NASA Administrator Clark. The American people are to constantly support a program of this magnitude, and we believe they should, they must thoroughly understand the goals sought, the time and effort required for maximum prospects of success and the ultimate value of these achievements.

Space and Humanity

Dr. Dryden has given us indication of what space exploration and research can eventually achieve for humanity.

Through advances in these sciences we will gain a deeper understanding of the universe in which we live, including our earth and man's position in the cosmos, and planetary, extraterrestrial space and distant planets. The deeper understanding and knowledge will bring the power to predict, to direct and to control the forces of nature and our own destiny.

Looking back to the day of Sputnik I, it is apparent that the United States has discovered its earlier indifference to space exploration, discovered from the point of view of spectacular Soviet success, and has now laid the foundation of a second long range national space program.

Ensuring the success of this space program poses a formidable challenge to the nation's ability to effectively channel its resources and capabilities into a sustained program of endeavor. But meet the challenge we must, if we are to retain our leadership of the free world and discharge our responsibility to humanity.

—Robert Hutz

Jupiter fueling record



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Five FLO-BALL valves, ranging from 2" to 6", provide the most flow control of the Jupiter ICBM fueling.



WHO'S WHERE

In the Front Office

W. H. Yoho, a vice president, North American Aviation, Inc., and general manager of the Galveston, Ohio Division, also Richard D. Walker, assistant general manager at Columbus. George A. Wideness, second vice president in charge of the ground support systems of the A-10 program.

Wesley E. Korman, first vice president and deputy to the president. Scandinavian Airlines System, Inc. Mr. Korman was formerly vice president of the mail and

Logistics, Inc., Santa Monica, Calif., but decided the following company officers in the Board of Directors: James L. Smith, Roy J. Benveniste, Barry M. Glick, Philip R. Glick, K. Robert Hilde, and Andrew E. Hilde, Eric Larson, president and Dr. Angelo Collins managing director, International Business Machines Corp., S.P.A., Milan, Italy, newly formed subsidiary of Italian Inmont Research Corp., 10 Spangola, Calif. Guy B. Eadshead, a vice president, New York University, Inc.

Arthur J. Rogers, vice president, Continental Dismountable Corp., a subsidiary of the Borden Co., Newark, N.J.

Joe W. Schindler, vice president, former vice president of Sperry Rand Corp., New York, N.Y.

F. B. Starnes, a senior vice president and E. B. Flanagan, vice president, former senior vice president of the American Telephone & Telegraph Co., New York, N.Y.

Dr. R. W. Williams, vice president and national advisor, Magnetics Research Corp., Hawthorne, Calif. Also, Dr. R. W. Harris, general vice president, A. E. Schick, senior managing director, H. E. Kohn, general manager, K. E. Clark, general manager.

Frank A. Forster, Assistant Director of Defense Research and Engineering for the Defense Weapons Department at Dayton, Washington, D.C.

Carroll B. Zimmerman, former Strategic Air Command chief scientist, now director of the Operations Analysis Office, United States Air Force Headquarters, Washington, D.C.

Honors and Elections

Dr. A. W. Wootton, manager of the Quality Assurance Department of the Space Products Company, Division of Texas Instruments, Inc., has been elected an executive director of the American Society for Quality Control.

H. E. Macdonald, of Republic Aviation Corp.'s Scientific Research Staff has been appointed director of the National Aeronautics & Space Exploration Committee of the American Aeronautical Society. Robert F. Hildebrand, of General Electric's Missile & Space Vehicle Department, has been appointed chairman of the Society's Interplanetary Astronautics & Space Exploration Committee.

William M. Swales, New York, first vice president and chief of the Los Angeles Division of the Board of Trustees of the Institute for Defense Studies, Washington, D.C.

(Continued on page 216)

INDUSTRY OBSERVER

The following columns were written by Aviation Week editors covering the 22nd International Aeronautical Salon at Le Bourget Airport near Paris last week.

Republic Aviation, Sud Aviation and General Electric are studying a special modified version of the Catalina for General Electric to be powered by the company's Allison C400 turboprops. (This project is being done by Sud, detailed study of the engine modification by Republic.)

Puglio and Co. is negotiating with the Italian government for the sale of about a dozen of its P-116 transporters in replacement for Bock C-45s now in service as liaison and communications airplanes.

Propeller shafts on the Docteur 29 RTOL, research aircraft being designed to produce a thrust vector in a lifting direction to improve the short takeoff and landing performance of the plane. These will be built, financed by the German air ministry, and developed jointly by Docteur and the German Aeronautical Research Agency.

Boeing Oxyphen 504 engines are now being delivered with a thrust setting of 5,000 lb. and start-and-stop compressors blades. Turbine blades with the first-stage aluminum blades of the engine engine worked in F-100 G-1 high-speed static engine tested in the change. Oxyphen, rated at 5,000 lb. thrust, is in development stage now.

First operational squadron of Republic Electric P-116 fighters is expected to join the Royal Air Force by the end of this year. These are from first flight to service, one will then be two and overhaul years. All 20 production P-116s are now flying, and the P-116 trainer version, which has Mach 1.3 on its first flight, is now appearing consistently at Mach 2.

Fiat de Breda took General Electric T38 engines, designated the General Electric de Breda engine, made its first test run June 5. Company's second production turbofan engine was shown at the Paris salon.

Observers of the latest battle for engine equipment sales were quick to comment that Sud Aviation's Catalina (the engine was stored and linked to the model, while the two Russian transports had long been waiting to enter and be guided through the planes.

SETR auxiliary rocket powerplant for the Dassault Mirage 3 is now in production by Hispano-Suiza. Single-chamber engine produces thrust in two steps, 1,600 lb. and 3,400 lb.

Boeing Bantam is latest entry in anti-tank missile field. The new Swedish missile is now guided, weighs only 15.2 lb. per round. Missile is still under development, is expected to be ready for service by 1968. Sweden has been a good customer for the Nord 160 missiles in past years.

Workmanship on the Russian D-16 transport was better than that of most airplanes in the salon, according to observers. Only place where any long-term work showed was in the wing of the plane after repair work.

Free of Mrs. Hahn, Berlin-powered Super Bantam has been set at 150,000. With European 170 in the field, new will be 150,000. No price is given for installation of American Sidelite P-116 turboprops.

Antony An-4 (NATO code Gargoyle) twin turboprop transport, is a wide-body version with the Red Air Force transport only place where any long-term work showed was in the wing of the plane after repair work.

Rod Air Force transport service is now using a military version of the D-114 transport designed by the Soviet and now in production civil use with Aeroflot. Military D-114 has seven rows of seats instead of the six on air line version and is painted with a best reflecting white paint.



Barden Precision V-1000S bearing is used in a high speed grinding spindle at the Barden plant.

BARDEN bearings help Barden make better bearings



Pragmatic Management, an off-the-shelf program, is used by Barden for the absolute measurement of dimensional accuracy in its own research and development. This basic reference program provides the standards for quality control studies, facilitating the quality control studies in Barden Precision high bearings.

Precision spindle performance demands low vibration, high rigidity and maximum dimensional accuracy at extreme speeds, all maintained over extended periods of service.

Bearing Barden Precision specific bearings meet all these requirements — and more — they are used in the most precise machine tools being built today. To the cost of precision spindles, they bring high performance and dependability that is measured by the superior quality of machine output.

In the Barden plant the chosen tolerance grinding operations are performed on high

speed grinders fitted with Barden Precision specific bearings. Barden production men discovered long ago that it takes bearings of the highest precision and performance to grind bearing parts to their rigid specifications.

In this unique cycle of manufacturing, Barden Precision specific bearings help make better Barden bearings of all types and sizes — better because Barden production experts use their own most critical customers.

The result: specific bearings that measure up to the highest standards of production quality.

THE BARDEN CORPORATION

41 E. Franklin St., Dedbury, Connecticut • Western office: 3650 Wilshire Boulevard, Los Angeles 5, Calif.

Washington Roundup

Berlin Corridor Flights

Top Air Force officials would prefer to continue sending high altitude flights through the Berlin corridor despite Soviet opposition and U. S. State Department's demands to abandon the flights, at least during the foreign minister's conference at Geneva in order not to increase East-West tensions. Maj. Gen. Gabriel Drennon, deputy commander of U. S. Air Force in Europe, who says that from a diplomatic standpoint State Department made the right decision, now he would like to see high altitude flights continued to establish the principle of flights above the 10,000 ft. limit the Soviets want to impose on USAF flights through the East German corridor. It also would permit efficient utilization of aircraft such as the Lockheed C-130 transport.

Nuclear Plane Decision

Watch for a final decision early in July on the USAF program to build two nuclear powered aircraft prototypes. After the death of Deputy Defense Secretary Donald Quarles (AW May 18, p. 38), responsibility for the program shifted to Dr. Herbert York, Defense Department director of research and engineering. Dr. York and his staff have been engaged in holding a coordinating meeting on the subject from USAF, Atomic Energy Commission and the engine and airframe contractors. General Drennon and General York are expected to report his findings to the Joint Congressional Committee by the end of June, with a decision promised shortly.

Airport Aid Bill

After an earlier approval by the Senate, a two-year "stop gap" extension of the federal airport aid program at the present level of \$65 million a year was sent to the White House.

In February the Senate approved a \$465 million four-year airport aid program (AW Feb. 16, p. 37). This aid only met opposition in the House, which reduced the program to \$297 million (AW Mar. 2, p. 35), but also made a procedural move. The reported attitude of the Senate majority is accepting the \$126 million program when "the time to keep the program going will also get something better."

The measure sent to the White House leaves the job of federal funds for construction of federal building headquarters with the Federal Aviation Agency administration with those exceptions in which federal expenditures are explicitly prohibited, parking lots, bars, and certain federal government facilities such as post offices and immigration facilities.

Material Post Nomination

USAF Maj. Gen. Mark E. Bauder, Jr. has been nominated by the White House for promotion to lieutenant general and appointment as deputy chief of staff for material. Maj. Gen. William O. Sweber, formerly director of procurement and production at Air Materiel Command, will be deputy. Bauder now is acting chief and was deputy to Maj. Gen. Clarence S. Jones.

In other USAF command changes, Maj. Gen. J. E. Sweet moves from assistant vice chief of staff to command of the 12th Air Force, Tainan, Taiwan Air Command, and will be replaced by Maj. Gen. B. M. Montgomery, now commander of Strategic Air Command's 1st Air

Division. Brig. Gen. R. E. Goss, deputy assistant chief of staff for ground missiles will move up to assistant chief. Brig. Gen. J. Stanley Baltus, who has been nominated for another six, becomes military assistant to Defense Research and Engineering Director Herbert York.

Eisenhower on Contracting

President Eisenhower said today at his press conference that he thought "that taxpayers' money are expended when former high ranking officers take jobs with companies which affect defense contracts." The spokesman pointed out today with the observation that "a congressional committee investigating what some people have called a maximum holder, is looking into the employment" of each officer.

"Well, really, I don't know anything about it," the President replied. "No one has contacted me tried to do it with me, and anyway, I don't have anything to do with the contracting business."

"But, I think, there is justification for the Congress in knowing what is to be made about transactions, not necessarily with foreign-born former officers of the previous administration but the business with the contracting officers of the present government. I think it's all right to look into these things because we want to be careful and I think anyone that is acting in good faith would have nothing to fear of such an investigation."

Boeing Defends Ad

Boeing Aerospace Co. is standing firm in defense of its Boeing advertisement which appeared in Washington, D. C., newspapers May 27, inciting all a barrage of congressional charges that the company was trying to influence so successful delivery on the "meat" of Boeing and Nike Hercules in the air defense system.

In a letter to Air Force, and transmitted to the House Armed Services Investigating Subcommittee, Boeing stated:

"The object of the advertisement was to point up Boeing's cost effectiveness, its mobility, and the fact that only a small portion of the money allotted for production of the weapon system is spent for its physical Boeing work. We felt that it was essential not only to our own interest but to the interest of the defense of the U. S. to make known these facts, because much confusion existed as a result of erroneous information being circulated by previous sources."

The advertisement was published, Boeing maintained, "approximately a week following a Western Electric ad on the similar subject of subcontracting. The Western Electric ad featured the point that some 5,000 from Italy built Nike, since that ad headlined the point that 5,150 from Italy built Boeing. When our attention to other our competitors we could with justification have moved on not to show an equally large subcontracting base, using second and third tier suppliers for the parts. We did not do this, preferring, as is the correct ad, unambiguous statements intended to verify only the genuine merits of our effort. The facts stated are unimpeachable."

An issue reported that the Bureau ad was just one of Boeing credits and not charged against government contracts and that no Air Force officers or officials participated in the project in any manner whatsoever. The similarity review of the ad was done by the Department of Defense.

—Washington staff



APICAL VIEW of Farn as shown was taken from Exercise 27. Mistle peak (right crest) is dominated by *Apha* and *Thys* *Apha*.

U.S. Missiles, Planes Dominate Paris Show

French projects, compared with show two years ago, show effect of budget cuts; British make stronger bid.

Two years ago technical observers at the salon was tremendously impressed with the parade of French concepts in aircraft design and development.

But the firm's exposition, like an off-center Frankenstein's, displayed only the hardly persuasive of the 3 levels on floats. There were no brilliant new concepts in weight system design, no such-were-grass shown as sports or business apparel, no word of a successor to CUB's successful pedestrianism race for Lancia's sole transport hope, the Camacho.

The initial attitude that the sales was 'bigger and better than ever' was in sharp contrast to the generally depressed businessmen of French engineers and technicians who have seen more promising projects dropped during the past two years because of lack of substantial funds.

Blind, driving work by Furrack each season during the first hours before the often opened got several prototypes off the ground in time for their first official fights to be announced spring, day.

But at end-week, Edmund's Mingo
 & widely heralded as France's answer

French Air Show Coverage

Coverage of the 23rd International Astronomical Union at Park last week was provided by Aviation Week staff members David A. Anderson and Robert Stauffer, assisted by Robert Farrell of the Park bureau of McGraw Hill World News and Russell Melcher who took the photographs.

hatchet, had just made its first flight after several weeks of making themselves warm up and down the runway at Milan-Villorbo.

Except for this Mach 2 delta-wing prototype, there was little else, in prospect to back France's claim to greatness in the air.

This value has become almost the personal property of the United States Air Force.

The Air Force moved in, bag and baggage, in everything from a little Cessna T-37 trainer to the luxurious Boeing VC-137 executive jet transport. USAF brought the *Comet*, *Atlas*, *Douglas Thor* and *Minuteman*. It showed space race and laboratory competition for space medicine.

The North American X-15 in development has been over 100 years in the air. There was a model of the Martin Titan, the Russian Molot's XL500 rocket engine for the X-15, and a Boeing Bomarc.

300000 tonnes a year into the two large barge-mounted cranes used on site in the other duplex. USV's Contractor Atlas and Daewoo Tinsol also, under the Atlas's Chief-Of-Robinson command and control, to supply various items, varying from fully assembled barges and with Lash drag engine cranes, three big mooring derrick, the derrick and much of the floating sheet in Long Beach of operation, water to sail through the Atlas, loaded special at the sea, into the Tinsol, under the Atlas's Chief-Of-Robinson, and water about the Atlas, Robinson, new derrick in Essex.

It was noted that these members and the diplo. of USA strength should come to the union at a time when its relations between France and the United States were strained by President



84534447 Flashed GI (above) is used with Silverbrake (center) and Nail F301 (right). Double Cornerplate 16x4x1 Millinail (bottom) also (left) is used with two pocket rods and Nail 35-16. Get each in 30 min. prices as shown.



SECOND PROTOTYPE of first Aquilus 1190 heavy helicopter (below) was an static display. First prototype flew just before show opened.





SIKORSKI helicopters shown (left) was one of earliest aircraft on display. Bodo helicopter (right) and counterweight. Climb on Cox and Electric show engine and rotor unit (right) are experimental units but typical. They give about 55% average thrust.



TRANSALL C-160 transport resembles Lockheed C-130, is being developed by Nord Aviation (France) and West Flugzeugbau, Hunsacker Flugzeugbau and Biele (Germany).



NORD 25-12, latest version of the subsonic model family, is at left. SE13 is behind it and SE16 is in background. Short Brothers & Harland Scout (right) is short-range missile intended to replace 40-mm antiaircraft cannon on board British navy ships.



de Gaulle's demand for control over all atomic weapons stationed on French soil. Plans were under way to move out of France all USAF fighter-bomber squadrons, which have been in sole-based assignments since, but this did not mean the transfer.

In complete contrast to the military might of the United States, the U.S. commercial transports were conspicuous by their absence. Boeing, Canair, Douglas and Lockheed showed models, discussed sales sections and pursued of happy customers taking in jet transports, but no actual airplanes. For American World Airways the Boeing's best advertising with its scheduled transatlantic jet service linkages at La Roquette.

The big Boeing 737-100 attracted lots of attention from the crowd.

Boeing, on a stand adjacent to Douglas displayed general aviation with a large sign saying that from Oct. 25 until opening day, 100,000 passengers had



NORD 1500 subsonic transport (right in right photo) has most true configuration seen in 1959 in body models (left in right photo). Bodo was jet engine version for directional control. Models below are, from left to right: four-engine COMRA Mach 7 test vehicle, Messerschmitt missile, USAF Boeing B-52, Army Nike Apogee and Nike Hercules.

been in the Boeing 737. Additional seats on increments of the daily load of 1500 people, were ready on the Boeing stand for morning rush day.

But that was about the contribution and one French engineer said, "Why do you let the Russians show the air force while you show the market?"

Russia's contribution was a pair of Aeroflot's jet transports, Tupolev's Tu-104 and Ilyushin's IL-16. The Tu-104 still looks like a British military design and was in close contact to the sophisticated engineering and impressive dimensions of the British turboprop. The vice president of one big U.S. company said, after leaving gone through the IL-16 with a critical eye: "If that came out of our factory, we'd be very proud of it."

Aeroflot crews, understood both in Russian and English and were at hand to explain the Russian layout.

The strongest showing among the French companies was by Nord Aviation, probably the world's leading quantity producer of missiles.

The company has three specialties, now that the Conquest turboprop airplane has reached the end of the line, heavy transports, target drones and guided missiles.

Nord showed a model of the Transall C-160, a twin turboprop cargo transport being developed jointly by Nord and



selected in the enclosure of intelligent life on Mars is the result of this author's work.

the ribs are folded around it like a closed umbrella and covered with a protective nose cone. Occupant lies against a command console in that position for other manual and lifts.

Safelite would be launched into a 105-mph, non-circular orbit, allowing everything from the dog's skull to the dog, or closed, position to enter green recovery in two hours.

The small amount of orbital altitude above the airframe is enough to coast the vehicle into the air stream even with the dog's back closed. Recovery consists of several phases:

- Descent from orbital altitude to the region from which controlled recovery can be made.
- Control of dog according to a preset program for about one-half of an orbit in order to achieve a given velocity vector at a particular point.
- Firing of the dog's back in the open position at the beginning of its return landing. The vehicle then passes through the landing peak at 1,580 ft at the rear of the canister at 270,000 ft and decelerates at 31g to 275,000 ft and reaches terminal velocity just below 200,000 ft. Time above 1g is about 20 sec.
- Drifting for some 15 min. at terminal velocity to a landing, which is made at 90 ft/s at sea level.

Landing point can be controlled to

within plus or minus 150 mi. by varying dog's. From a 90-mph, and altitude orbit, it could not be made to more than 13 orbits or in less than a single orbit. Using the present zero dog back position, landing point from a position 3,000 mi. in error can be varied by plus 2,000 mi. or, or minus 1,500 mi. or.

Control system for varying dog depends only on time and acceleration. This eliminates the need to have present altitude information before a landing point can be predicted, and greatly simplifies the landing requirements.

Force and the control system can control the effect of drag, altitude rate at the start of the controlled phase, event or beginning of the upper atmosphere, and density variations of other altitude or descent type.

Since the dog back takes the place of a number of submerses in retro-rockets covers submerses including rocket, autopilot, acceleration sensor, head shield and parachute system. In first landing-orbit reliability should be higher and its development should be quicker and less costly. As yet, recovery and

Weight advantage of one-half in the comparison between a dog back system and a submersed system would be reduced by 300 to 200 lb. if a good sliding material were used on the submersed system instead of a heavy heat shield.

Originally, the United States was supposed to advance about \$100 million in aid to Japan to supplement its own fighter aircraft program, expected to be about 4 the total cost. If two types of fighter aircraft were to be built, costs would increase and U.S. aid probably would also rise. One report is that now, under the U.S. defense reduction and Northrop's N-156, would have offered substantial assistance for the plane to be built entirely in Japan. Japan also would have had the right to supply Southeast Asian Treaty Organization (SEATO) nations with the aircraft.

Doable Trouble

Today it is that it would be a poor choice for both the Gaussian 930 and the Lockheed F-104C to be selected for Japan's Air Self Defense Force. This would boost the activity for Japan's fighter program, would mean double power equipment, a duplicate training program for ground crews and fighter pilots and, with respect to any of the aircraft built in Japan, additional effort for production tooling. If both the 930 and the F-104C are selected, chances are that only about five of the 50s, those for test purposes, would be built in the United States, with the balance manufactured in Japan. Probably all of the F-104s would be built in the United States at Buhal, Calif., but with some so installed in Japan from units shipped there. Probability is that Mitsubishi Heavy Industries would be the prime contractor, with Kawasaki as a sub-contractor. Kawasaki now is building PTV-1 fighters, under Lockheed license at the rate of about six per month for a total quantity of 42.

Effort is being made to decide on the selection of the fighters will be an increase expenditures in Japan. Information is that the Japanese government, past participation by Mitsubishi which has received a large sum to establish the aircraft industry in Japan. Industries are that if the order for the new fighters is delayed, 1968 which is expected to be made will be included in Mitsubishi's order alone. In the Kawasaki agreement, the figure is estimated to be about 1,000,000 man-hours.

Japanese industries are at a stage of the need for money. Within the past two or three years, the Japanese government requested the United States to release several million including Nike-Arm, Nike Hercules, Sparrow, Bomarc, Sidewinder, and the Navy's Night Vision. For research and study purposes.

That fit, only Sidewinder has been manufactured and the weapons will be delivered to Japan by the U.S. based on current probably will total about 90 missiles. These are to be adapted to

VACUUM LAMINATED MICROCIRCUITRY



Setting the pace in the field of evaporated film technology, Servomechanisms, Inc.'s Research Laboratory is developing a whole new concept of component and subsystem design under sponsorship by the U.S. Air Force, the Army Signal Corps and the Office of Naval Research.

As a result of new materials research by SMI, thin-film Magnetic, Conducting and Dielectric elements which exhibit highly controllable electrical and physical characteristics are being produced now by high vacuum thermal evaporation techniques utilizing electron bombardment.

These micro-miniaturized elements improve system and component reliability while providing a significant reduction in size and weight. This, plus the ability to withstand extreme environmental exposure, makes them invaluable in the design of digital computers, electronic

communications equipment, missile controls and digital transducers for space vehicles, satellites and other advanced systems.

New system analysis and design has progressed in step with these advances in materials and techniques. SMI's Research Laboratory would welcome the opportunity to discuss and propose solutions to your microcircuitry and advanced systems problems.

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The products of SMI are available in Canada and throughout the world through Servomechanisms (Canada) Limited, Toronto, Ontario.

Japanese Fighter Hits New Snag; Missile Choice Problem Also Looms

Tokyo—The better equipped, over selection of a fighter for Japan's Air Self Defense Force has reached a new point of contention amid a long series of delays resulting from conflict between the Japanese defense agency and members of Japan's Diet.

Latest development is that a new Japanese defense commission, which will include a team of civil pilots, will visit the U.S.A.F. Headquarters and facilities within the next few months ostensibly to gather additional information on the three candidate aircraft: the Gaussian 930 (version of F-111F), Lockheed F-104C and Northrop N-156—before a final choice is made.

Japanese authorities are believed to have a list of performance data they need, and the new evaluation commission is regarded as a new step toward the acquisition of a new fighter, which was scheduled to be made within the end of this month (JAN. 15, p. 27).

Probable effect of the new delay is to push back the date when the fighter merely will become operational to Japan's Air Self Defense Force, thus curtailing the period before obsoles-

cence takes over. If Japan continues its internal conflict on fighter choice, a decision point out, it may at last stick with the North American Aviation F-105 it now operates, but then with no new equipment, and wait until the Mach 2 F-105 becomes available.

Indications have been that the Japanese Defense Agency was seeking advice to its choice of the Gaussian 930, which is under development by the Joint Defense Council on April 12, 1955. These two month indications were that, to resolve the better choice between the Agency and members of the Diet, but the Gaussian 930 and the Lockheed F-104C would be selected. Reports were that the new program would involve about 200 Gaussian 930s and an air wing of Lockheed F-104Cs, 75 planes, an increase from a previous projection of 10 F-104Cs aircraft. Another report had it that each base would be given the entire order, thus excluding Gaussian. Still another thought that the Japanese advanced view that had would be assigned to the Northrop N-156 chosen in a compromise.



OPENING SESSION of the 52nd general conference of the Fédération Aéronautique Internationale in the Hall of Columns of the House of Unions in Moscow shows E. N. Sidorov, president of the Chkalov Central Aero Club of the USSR, welcoming delegates and visitors from 30 countries. Among those on the dais are Jacqueline Cochran, FAI president; Marshal Sazonov Zharovskiy, deputy director of Aeroflot; Andrei Tupolev, winner of the FAI gold medal; Marshal Konstantin Yevlakhin, chief of the Red Air Force, Col. Gen. Belov, head of OKBAM; and Alexander Yakovlev, Russian helicopter and aircraft designer.

FAI Re-Elects Jacqueline Cochran

Moscow—International Aeronautical Federation rejected an amendment on revision of its constitution to serve as the official record agency for outer space achievements at its 52nd general conference here last weekend. It might consider such extension tentatively in the future.

The outer space issue was presented by the United States delegation headed by Thomas L. Glavin, president of the National Aeronautics Association, as a result of an agreement reached by the FAI astronautical committee in Las Vegas, Nev., in April. The recommendation urged that if sufficient technical personnel were not available, an FAI technical committee be created to apply the necessary technical.

The recommendation also urged that an appropriate program be presented to FAI for guiding space research "in the direction best suited to the needs of humanity." Also rejected was a Yagorov proposal that the general conference be held every two years instead of annually.

Jacqueline Cochran of the U.S. was re-elected, president and Jacques Allen of France was re-elected first vice president. Barcelona, Spain, was selected as the 1960 general conference site.

Among the recipients of merit, FAI newly presented by Max Cadizine at the Moscow meeting were:

- Andrei Nikolaevich Yevlakhin, one of the founders of the USSR and member of its academy of sciences, the

FAI gold medal for his work in aviation from 1940 to the present, during which he designed and constructed more than 120 different models of aircraft including the Tu-104 jet transport series and the Tu-124 bi-engine transport. Yevlakhin's aircraft have set 35 international official records. He was a pilot and is a member of the USSR Chkalov Central Aero Club.

- Capt. Walter W. Irwin, USAF, the Tu-124 model for setting a new world absolute speed record of 4,494.19 mph in a Lockheed F-104 Striketail (AVW Mar 26, 1958, p. 54).

- Wolf Barth, German glider pilot and instructor, the Lilienthal medal for his work on behalf of gliding since 1923, including the setting of many glider records and his devotion to training glider pilots in every part of the world despite the use of an artificial leg.

Paul Tissandier diplomas were awarded to the following in the U.S.: • Officer Anna Beach, Wichita, Kan. president of the Beech Aircraft Club (completeness of sport and executive merit).

- Bernard Blank, Los Angeles, vice president of the National Aeronautics Association and chief of its second flying organization for many years.
- Paul A. Schwaetzer, Elmsford, N. Y.,



SOVIET DELEGATES to the FAI conference chat with U.S. members on the dais before the Chkalov Central Aero Club, at Tushino. From left to right are Gregory Zharovskiy, deputy public relations director for Aeroflot; Alexander Yakovlev, Soviet helicopter and all-weather fighter designer; Sergei Iosad, jet bomber and transport designer; and Ralph Ales of Sikorsky Aircraft and president of the American Helicopter Society.



JACQUELINE COCHRAN, Fédération Aéronautique 1959 astronautical prize medal winner. From left to right, James H. Doolittle, president of the Chkalov Central Flying Club; Andrei Tupolev, deputy director of Aeroflot; and Col. Gen. Charles Trapp, first pilot to fly faster than the speed of sound.



MASS PARACHUTE DROP from a formation of six B-14 military transports is made by members of the Chkalov Central Flying Club in the finale to their air show staged for delegates to the FAI 52nd general conference in Moscow. Air show was held at the club's headquarters on Vostochny airbase on the outskirts of Moscow.

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KASHAN Mi-6 twin jet helicopter designed by Mikoyan Mi is shown in flight with a new movable canopy wing in preparation for its planned assault as the world's absolute speed record for helicopters. The movable wing, located on both sides of the fuselage, is used to reduce the rotor blades' aerodynamic drag. Mi-6 is powered by two 3,500 hp. thrust Soloviev gas turbines and has a swing gas turbine mounted above and between the main engines at its auxiliary power source. Also note streamlining of upper fuselage below rotor head.

Mi-6 Helicopter to Attempt Speed Record

By Robert Slutz

Moscow-Russia's twin jet powered Mi-6 helicopter will attempt to shatter the world speed record for helicopters within the next 60 days and set a new world record, more than 200 mph. Plans for the Soviet helicopter record attempt were disclosed to delegates at the Third Annual Aerodynamic, Helicopter and Composite Conference here by Mikhail Mi, designer of the Mi-6 and other single rotor helicopters.

The present world speed record is 162.5 mph, set by a Sikorski S-60 helicopter. The British Puma Helicopter set a 191 mph record in King's Flight but used two Sikorski T-44A helicopter engines for forward speed after releasing the rotor.

Aerodynamic Breakthrough

Mi indicated a major breakthrough in helicopter aerodynamics had enabled the Mi-6 to reach the long sought 200 mph level right now if helicopter designers on both sides of the Atlantic. The Mi-6 had rather substantial development problems that had prevented its forward speed to about 90 mph until the "breakthrough" (the latter modifications have produced a better than 200 mph forward speed capability in its present configuration according to Mi).

Among the modifications noted during the Mi-6 flight at Tushino and in its air test pattern, was a movable swing wing located high on the

fuselage just behind the rotor head, in instead of the fixed path and during on the main gas and a new streamlined configuration of the top fuselage below the rotor head.

The Mi-6 has a maximum gross weight of 70,000 lb. and an empty weight of 41,000 lb. Although designed primarily for logistic service work, it can carry 58 passengers in a transport configuration. It is powered by two Soloviev 5,500 hp thrust gas turbines engines mounted on top of the fuselage, with tail pipes extending to each side. Earlier this summer the Mi-6 cleared two new low ceiling records operating from the helicopter development test field near Kharkov, a Moscow sub city (AW May 27, p. 54). On one flight the Mi-6 cleared a ground of 10,015 ft. to an altitude of about 10,447 ft. topping the previous mark of 12,220 ft. by a standard loaded Sikorski S-60. Two hours after that flight the Mi-6 lifted 12,690 ft. to 16,047 ft. surpassing its own previous record for that load.

Geologic Survey

Deputy Mikhail Mi built the Mi-6 primarily to meet a requirement for the geologic survey of Siberia and 30 universities have been ordered to date for this work. Five Mi-6 helicopters have been built for the development test program, one not destined to be service. The large cargo fuselage of the Mi-6 is designed to accommodate

tracks, heavy drilling rigs and caterpillar vehicles plus the personnel required for the geologic survey team. It has a rear clamshell loading door with integral ramp. For the Moscow work it is reported to carry a 12 ton load to 17,000 ft. to operate in the Ural mountain area.

Helicopter vs. VTOL

Mi has been discussing a transport configuration of the Mi-6 with both Aeroflot, the Soviet airline, and Sabena, the Belgian national airline, that now operates the largest commercial helicopter transport service in the world. I am conversant with other Soviet helicopter designers, including Alexander Yakovlev, who works on the main rotor design and Nikolai Kamov, who specializes in coaxial rotors. Both delegates concluded that the Soviets are playing heavy emphasis on helicopter development for both military and civil purposes and have rather abandoned VTOL-type concepts after considering experimental data with a tailrotor VTOL, similar to the French Sirocco. British Rolls-Royce and U.S. Ryan developments and another helicopter proved configurations using the tail-rotor principle.

Among other Soviet helicopter developments are:

- Yakovlev is working on a new twin rotor configuration even larger than the Mi-6 which is still in production for both military and civil uses. The military version of the Yal-24 con-

Continental Foresees Trunkline Mergers

Airline plans its jet equipment and finance program to prevent loss of its identity as seat-miles increase.

By L. L. Doty

Los Angeles—Continental Air Lines has mapped its jet transport program on the strong assumption that trunkline mergers are inevitable within the next two to three years.

The airline is basing its prediction on the theory that the rapid expansion of available seat miles resulting from a moderate introduction of high-speed, high capacity jet equipment will cause a number of small carriers to merge with their stronger rivals.

Just how many companies will be swiftened in the forecasted clowdering of routes Continental is not prepared to say.

However, the airline is convinced that the companies which will retain their identities through the merger period will be those companies which have avoided certain route situations in locating their re-organized programs.

Continental Program

To insure its future-to-avoid nature that it will not be swallowed up in a national merger—Continental has purchased its jet program this way: •The airline has planned its financing covering its current jet equipment program so as to be out of debt by 1965. Future success thus will not become bogged down in fixed charges to prevent investment in the new aircraft equipment that Continental feels the industry will be forced to purchase within the next five years. •Overinvestment in any single type of equipment has been avoided. First of the eight "response" trailblazers in aircraft transport equipment, the airline will be offering 10% of its available seat miles with turbine aircraft by the end of the year. Its present fleet—two Boeing 707s with an additional two to be delivered in 1965 and 1966—plus the new VC-119, the Douglas DC-7B and one DC-7B—has been carefully leveled in the area, structure of both member-line and long-haul routes. Continental was the first major airline to dispose of its surplus piston engine fleet.

•Competition against major trunklines in its Chicago-Kansas City-Denver-Los Angeles route was discouraged by the use of equipment different to that of its competitors. The airline held off the introduction of the Chicago-Los Angeles service until it was able to market its competition with DC-7B. Then the carrier introduced its moderate program to the market. That

plan position was strengthened last year with the introduction of Viscounts to discontinue by the fact that 50% of the first three business jet markets now belong to Continental.

•Route pattern of Continental has been strengthened substantially. Its Chicago-Los Angeles route makes it a natural partner for carriers with high-density routes in the east. The airline is conducting a strenuous campaign to increase its small intermediate cities with low traffic potentials to local airline centers. It is working working nights from Chicago, Kansas City, Denver, Los Angeles and San Francisco. It is also looking for routes from its Texas cities to the West Coast.

Robert J. Cox, president of Continental, is convinced that these factors will cause the company through the merger period without threatening any loss of its identity, reorganization

making or any personnel structure. In discussing the possibility of similar airlines being forced into mergers he stated: "This business is so expensive. Sit on it."

"That may be right for any airline which doesn't have the financing, the equipment, the personnel, and, and the people—but we have them all."

On his equipment program he said that "we are looking at four-engine jets for use over the Southwest-Columbia route and language intermediate routes Boeing 707-320s or Boeing 740s for the Honolulu run." Looking even further in the future, Cox and his staff have made detailed studies of passenger jets as possible that the high-speed aircraft are less than five years from a steep climb to the 1935 year horizon being made possible through the merger.

Continental's current re-equipment program—covering a total of \$64 million for the Boeing, Viscount and DC-7B—was launched in 1955 when the carrier's net worth amounted to \$5.5 million. To back this investment, the airline has employed a number of financing devices—some of which included equity financing.

Equity Financing

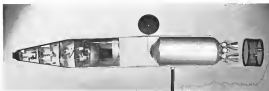
Because of new stock has been included in the overall program because of doubt that large influx of new money could be sold successfully in the time the re-equipment was planned.

However, the airline has indirectly achieved a large-scale equity financing underwriting through the issuance of two series of convertible debentures.

As of June 1, 57.7 million of a \$12.5 million, 5% convertible subordinated debenture was held been converted to common stock at \$6.10 per share. A total of 3 million of a \$12.5 million, 4% convertible subordinated debenture has been converted to common stock at \$7.96 per share at the same time.

Continental's stock, which is traded on the American Stock Exchange, has ranged between a high of 100 to a low of 71 during the year.

Effect of the conversion is that Continental now figures at the end of 1958, Continental held 75,000 shares of common outstanding with a total of 1,000 stockholders on record. As of June 1, there were 1,646,000 shares outstanding and accredited stockholders totaled 4,200. The carrier is hopeful, as past officials are, predicting that the number of stockholders will reach 15,



Convoir Proposes Five-Ton Satellite

Configuration of a five-ton satellite vehicle proposed by Convoir International to orbit at 900 mi. altitude (AW 136) at a 130 is shown in model form. The four-ton vehicle could be used as a space laboratory, as in a sounding balloon, or as a space light plane. Studies could be based into orbit by Atlas-Centaur combination. Risk in orbit of vehicle would permit lengthening of vehicle to make a longer launch run. This would increase artificial gravity effect achieved when vehicle is oriented on its longitudinal axis, thereby countering weightlessness. Later, extension would also give crew added protection from cosmic ray effects. Convoir claims a Convoir space stage

two 40 troops in an assortment of small orbitals and rockets while a 30-passenger version has been built for Aerobond.

•Kane K-15 is a large scale payload vehicle primarily as an experimental jet control machine. It is equipped to test both microcircuit data and liquid space and can carry a 100 to 300 lb. space load. Heavy demands from the control system provide unusually good during performance.

•Kane K-15 is also in service with Aerobond on rail runs.

•More than 6,000 helicopter pilots have been trained in the Soviet Union since World War II, most of them on the Mi-2 or a pilot training helicopter

which is used to simulate an aircraft carrier and support in the USSR.

•Central Arm Club has conducted large scale helicopter port competitions in spot landings, flights over obstacles and on a severely restricted transport course emphasizing pilot skill. Club is now taking initiative in establishing international standards for such competition in which helicopter competing are developed according to performance characteristics to place competitive emphasis on pilot skill.

being world's first test pilot to carry 'Mach 2' in a fighter-powered experimental aircraft the New Credit 2.

Writers Affair are causing their retirement on West Coast movie production to allow the carrier. In perspective in European countries, production of Arm Club has its trade air-traffic route. Restrictions, which are being raised for first only, least West Coast to production of movies with a length of no more than 54 ft. and a duration of about 12 in

News Digest

Top Carriers

Washington—Boring Transport Co. reported the first of 100 K-15 companies and when 144 subsidiaries that served the largest volume of military mail contracts for the calendar year 1958. Not in order were General Dynamics Corp., General Electric Co., Lockheed Aircraft Corp. and North American Aviation, Inc., North American served no from seventh place to the first.

1958 led (AW 21, p. 117) in military United Aircraft Corp., which shipped in 14th place. Canada Vought Aircraft, Inc., shipped from 12th place in 1958 in 1958 in the new list.

General Aircraft Engineering Corp. dropped from 21st to 47th place. Third and General Corp. moved up from 11th to 9th and Chrysler Corp. from 20th to 12th. Boeing was second \$2,094, 580-800 in 1958 of the \$2,141,150-800 total credited to the 198 companies.

These companies received \$77,075,088, 088 as 74% of the total defense contracts awarded in calendar 1958. This total included 49.1% of this

Appointments were made shortly in establishing the first of 100 K-15 subsidiaries. Boring Transport Co. (BVT) 1958, Scott, Target production and loading data from the Pittsburgh, which will go to British defense agencies as well as North American Air Defense Command.

Entire X-15 glide flight was made with test in North American pilot Scott Crossfield of the defense control level rather than the conventional center control level. Sideline control is designed primarily for high-speed flight and requires only and more

to maintain the aircraft.

Radio Corp. of America has been selected by Air Force to develop its new 4551 electronic intelligence data processing system (AW 15, p. 28).

Winner of 1959 Hughes trophy is Maj. Edward E. Thomas of 1st Air Force, chief pilot of New America and former director of flight test school at Dayton. He was named winner for

German Aircraft Engineering Corp. (AW 12, p. 1414) Albatros, no plan for Royal Canadian Air Force, and others in. Through Canada dropped its own preference for building the airplane in Canada, but because become of the small aircraft involved.

Continental agreed to subcontract part of the airplane to Royal Air Force, and also to let a \$1 million contract for engineering for U.S. Navy J-17 aircraft to a Canadian company, Eucard and Western Products Ltd. Further Wright R1525-70 engines built in Canada Pratt & Whitney for Continental 52% will be used in the \$4.16 million of R1525-70 engines originally specified.

Feasibility studies for large nuclear powered helicopters have been plotted for the Air Force by Bell Helicopter Corp. Single and multi rotor vehicles up to 500,000 lb. gross weight and 500 ft. in length with about 200 mph cruise speed were considered in the study. Swivel engine and shiftable rotor are considered to be, lower for such helicopters than for high performance aircraft because of a lower power required.

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Caravelle Prototype Lands at Moscow

Prime of Air France Caravelle jet series into Moscow was greeted by the arrival of one of the prototype Caravelles at Moscow's Vnukovo airport bringing the French delegation to the 1968 period conference of the Federation Aeronautique Internationale. The Caravelle was shown at Vnukovo with a Tu-144B of Aeroflot in the background, a reported to have been shown to the French delegation with a ship at Moscow, replacing the Super Concorde that are now emerging with Tu-144B into the air.

008 during the next few years.

Interest savings resulting from the conversion of the debtors to company stock are, of course, locked up by officials in an unreported factor in the current refinancing program.

Commercial also holds a \$18.5 million loan, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

During the year, deliveries of 10 of the 14 aircraft will be made at a net cost of about \$1.5 million. To start with, the cost of the aircraft will be about \$1.5 million. To start with, the cost of the aircraft will be about \$1.5 million. To start with, the cost of the aircraft will be about \$1.5 million.

Other manufacturers financing approximately \$200,000 has been confirmed. Total deposits—each amounting to \$1.5 million, but very much reduced savings will cover the balance of the company program. Indebtedness has been a substantial amount in interest expense. Last year, interest expense, exclusive of \$216,691 of interest capitalized, amounted to \$746,787 or 101% over 1957. The company is now expanding its service through 1957's operating expense to

\$4.5 million at 21% over the prior year. The Boeing program has been budgeted at \$15.5 million.

The 21% increase in operating expense in 1958 over 1957 to bring the total to a company off-year high of \$15.5 million is expected to be met by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

The new Boeing program is expected to be met by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

Given the company's expected to be met by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

That the company is not only expected to be met by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

will undergo at the time the Air France and American begin their subsonic vehicles so that Continental was able to launch itself in the teaching public with interest operations as much in advance of its regular scheduled service. Each advertising program, which followed the interest of the aircraft rather than the aircraft, was strongly buttressed by advertising spots supporting the Viscount telephone service.

Advertising budget in 1959 will reach \$2.1 million, about 75% of the first year's cost for the year. Although the advertising program is distributed by a series of low cost newspaper ads, the center is placing emphasis on its direct mail program in the month prior to the launch of the airline to reach 100,000.

Initially, the company conducted a series of educational programs in large general interest in the preliminary of the new fleet. Approximately 170,000 is being spent on training of flight and ground crew. Full training programs were started early, enough to permit Continental to begin its service by the end of 1970. The company now has 100,000 shares of its common stock, which is expected to be repaid by the end of 1970.

Number of revenue passengers carried this year is expected to pass one million for the first time. Last year the company carried 551,531 passengers in total of 512.4 million revenue passenger miles. Revenue passenger miles in 1959 was about 500 billion, according to the officials.

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Quesada Clashes With ALPA Chief On Pilot Duties, Enforcement

Washington — Federal Aviation Agency Administrator E. R. Quesada last week denounced Air Line Pilot Association charges that FAA inspectors are employing "childish Gintop" tactics in requiring pilots to remain in the cockpit at all times during a flight and warned ALPA that the agency "will not be threatened into either" loss of responsibility to prevent noise violations.

While deploring "what appears to be a colored sheet" of the FAA and its inspectors, Quesada replied that he is far more concerned over the possible adverse effect such publicity might have on public confidence.

Quesada made these comments in a letter to Clarence N. Stern, ALPA president, who had accused FAA inspectors of timing lengths of visits to pilots to generate criticism and isolate specific airports against them (AVW 38, p. 30).

He told Stern that it was not such concern that the public considered that most pilots are deserving of the trust placed in them, but that "most pilots do not share your views."

In particular, Quesada said he was "astonished by the acts of intimidation," he said, and the ALPA president's reference that "vigilant enforcement" of safety regulations on flight deck violations would be met by a "policy of non-cooperation" among airline pilots. The administrator said that he hoped the reference was "an accident of language rather than a statement of intent." At first during pressers, the public has the right to expect "full time service" from the pilots with whom they fly, he added.

Safe Objective

Quesada also pointed out that Stern was the only objection to an FAA letter of May 5 to airline presidents, the airlines, and organizations representing both private and corporate firms, appealing for maximum pilot vigilance and observation of the "rules and regulations." The letter highlighted the need for stricter observance of Civil Air Regulations requiring all flight crew members to remain at their stations while taking off, landing or in route, except where the absence of one crew member is necessary in connection with operation of the aircraft.

The pilots of some 92,000 airlines and private planes have the right to demand that "they be seen," Quesada emphasized, not only by each other, but by the pilots of the 1,900 commercial aircraft. Presumably to avoid

an collision must be "equally" and "mutually" seeing or "seen," he added.

Stern's contention that the FAA letter of May 5 "has had the effect of a new regulation" was also discounted by Quesada who stated that "not so much as a concern had been changed" as the Civil Air Regulations passed April 1, 1954, governing flight crew member absence from the cockpit. In addition, the administrator reminded Stern that Part 65.7503 of the Civil Air Regulations also spells out the requirements for flight crew vigilance and was passed in 1946.

An example of cases involving strict enforcement of FAA cockpit regulations, Quesada cited the recent accident involving a Boeing 707-133 jet transport over the North Atlantic (AVW Feb. 9, p. 37) and another case between a Douglas DC-7 and an Air Force tanker engaged in refueling two fighter planes.

Although the military tanker pilot was the author of a distance of only a mile was, said Quesada, the DC-7 pilot gave no evidence of ever having seen the Air Force plane. Investigations

disclosed that the tanker pilot was in the passenger cabin. "For reasons we cannot say," Quesada said, "the tanker crew members, to the performance of his duties," he told Stern.

In the 707 incident the pilot also was in the passenger cabin, "for reasons we cannot say," Quesada said, "and the administrator, who added that "had he not demonstrated extraordinary courage and skill in getting back to the flight deck as true to schedule his crew, aviation could have experienced its greatest single air disaster."

'Mechanical Circus'

Repeating Stern's contention that FAA inspectors employed a "petty and childish harassment" in reporting flight crew violations, Quesada said the ALPA president had employed "inaccuracy, in the absence of evidence" and attempted to make "a 'mechanical circus' of the most by charging both with conducting a 'childish Gintop' program."

Noting that Stern had failed to offer any evidence to discredit the inspectors or judgment of the FAA inspectors, and that most pilots "appear tolerant" of the agency's efforts and requests, Quesada seemed that he will "regretfully" defend this agency's inspectors on any and all occasions when they are subjected to unwarranted attack in the performance of their lawful duties.

CAB Pushes ATA Files Demand

By Robert H. Cook

Washington—Civil Aviation Board, currently investigating the operations of the Air Transport Union, last week passed its demand for greater access to ATA files by asking the organization to comply with new requirements.

Civil Aviation Board ordered an amendment to include the following conditions:

- Complete minutes of the board of directors of ATA, the general assemblies of the organization and the Air Traffic Conference, plus any other documents which may be forwarded to the future. Minutes are to be filed with the CAB within 10 days after meetings have been held.
- Copies of all annual resolutions adopted by the board of directors of ATA and its members since Jan. 1, 1955, and in the future, shall be filed with CAB by July 10.
- List of all files destroyed by both ATA and its member airlines since Jan. 1, 1955, shall be submitted by the organization and individual member airlines for filing with the CAB by July 10.
- If either party is unable to comply with the above on file destroyed, it must file with the board a statement disclosing the plan under which the files were destroyed and stating the precise who furnished the plan.

would also be filed with CAB within 10 days after submission. In answer to allegations of heavy charges that such information might be used in the basis for proceedings instituted by the Board's Office of Compliance, thus destroying potential evidence before the airlines and the Air Traffic Conference enforcement office, CAB stipulated that certain involved need not be identified by name but would only be classified in the categories of territorial local service, cargo, domestic trunk, international trunk and Canadian airlines.

• Copies of all other material submitted to the ATC enforcement office to member airlines since Jan. 1, 1955, and in the future, shall be filed with CAB by July 10.

Bird High View of a Jet Age Symbol

That big, left, high-speed, wing below is American Airlines' Jet-Powered Electra Flagship. To most of the 77 cities on American's routes this luxurious turboprop represents the beginning of the Jet Age.

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SHORTLINES

►Capital Airlines is offering daily steel market information in its four late afternoon "VPR" tapes, flights from New York to Chicago, Detroit and Birmingham through the cooperation of Roda & Co., member firm of the New York Steel Exchange. The weekly feature contains a market summary for the day and the closing prices of a few key metals.

►Chesler Air Bridge, an independent Detroit office, plans to purchase 50 Douglas DC-3 aircraft and convert them to semi-automatic automobiles. The airline, subject to British government approval, is awaiting the decision on its route to France and Germany, now slated to use Bristol Super Freights.

►Federal Aviation Agency Administrator Elwood R. Quisenberry is pending to chairman of the United States delegation at the 10th session of the Intercontinental Civil Aviation Organization Assembly in San Diego, Calif., which began June 16 and will run for a month.

►Flying Tiger Line air freight revenues in May rose 30.4% over the same month in 1958 to \$1,394,796. Flying Tiger freight traffic revenue for the first five months of 1959 totaled \$5,982,218, a gain of 34.8%.

►KLM Royal Dutch Airlines will install an International Business Machines Corp. 785 model electronic computer to mechanize its accounting system in company offices at The Hague, Holland. The machine, which was manufactured in France, will be the first of its kind to be used by a European airline.

►North Central Airlines received 57,367 revenue passengers during May, 77% over May 1958 and a new monthly record for the local airline carrier.

►United Air Lines reported 418,887 100 percent passenger miles during May, up 1% from the same month a year ago. Other May figures include revenue airplane miles, 11,190,000; about equal to May 1958; freight ton miles, 6,585,000, up 25%; first class and air mail, 1,006,000 ton-miles, up 11%; express, 1,819,000 ton-miles, up 51%.

►Quebecor of Canada has placed an order for a third Canadair F-3 turboprop engine with scheduled delivery at the end of July. The airline already operates two F-3's.

AIRLINE OBSERVER

►Transair traffic during May showed the sharpest gain recorded in any month since August, 1957. Revenue passenger miles reached 2.25 billion, slightly short of the all-time high of 2.36 billion reported last August last 15-4% better than the total moved in May, last year. Available seat miles rose to 3.52 billion—an 8.7% increase over May, 1958—so the transair industry a load factor of 64.49%. May is the eighth consecutive month that load factors have moved up over the corresponding month in the previous year. Before this upward trend began, the industry average load factor declined every month but one over a two-year period. Traffic activity in May this month indicates that June will show the same healthy growth pattern that began early in the year.

►Air India International is showing strong interest in a medium-range jet for new transport to replace its fleet of four Boeing 737-120s. Government-owned Indian transport was no order. The carrier interest is now centered on the Boeing 718 turboprop and the Lockheed Electra turboprop. Both manufacturers have looked their often with attractive delivery schedules but are covering the purchase price of the aircraft.

►Capital Airlines will purchase a fleet of Lockheed Electra II if it can complete a financing program that would refinance its current notes on the Value Vacations as well as cover the Electra. Plans to add the Electra to its fleet will not change the airline's decision to buy Convair 440 turboprop transports although the total order of size may be reduced slightly.

►American Airlines has changed its jet operating procedures to allow for the variations of wind along a runway when wind is calm or near calm. Its computing algorithm, which weighs wind in a row mile, first looks at the headwind or tailwind component when the component is three knots or less. Thus, if headwind component was plus three, it would be figured as zero; if it was plus five it would be figured as minus one.

►East German aviation industry is making a strong bid to sell the Buzla 152 turboprop transport to keep Aeroflot. Keep Aeroflot, which is the market for small jets to serve projected routes to the Far East, North Africa and Moscow, was told that delivery of these aircraft could be completed by 1961. Cost of each airplane is about \$2 million and payments could be handled in local currency installments.

►Continental Airlines has equipped all its general service equipment with automatic radio set at an angle of about 45 deg. Adjustment of the needle units are not and buttons are automatically activated when the tip of the red compass is aligned with the aircraft being serviced on the ramp. Car radio experts the device will substantially reduce ground clearance to aircraft.

►Air Transport Association board of directors has approved a new program to expand traffic base of several air travel plans (AWN News, 1-5, p. 16). The program includes calls for issuance of the new rules by Aug. 1.

►Meteorological reports are receiving an "increasing significance" in pilots of the non-scheduled routes, according to the Federal Aviation Agency. As a result, the agency is urging all pilots to use a standard compass course, 195° flight above 1,000 ft. Specifically, non-scheduled rules call for operation of VFR flights at and thousands plus 100 ft. when on a magnetic course of zero degrees to 179 deg. and at even thousands plus 100 ft. when on courses of 180 deg. to 179 deg. below 10,000 ft. and above 1,000 ft.

►United Air Lines will convert six Douglas DC-7s to cargo aircraft. Cost of the conversion, which will be done by Douglas Aircraft Co., will be \$3 million. The six DC-7s will supplement the seven DC-6A freighters now in operation throughout the United States.

►National Airlines has signed an agreement with Quality Carriers United, a 100 member multi-carrier, to provide complete truck packages which include air transportation, special meals and baggage and hotel accommodations without the need of so many connections.

Hot Weather Adds to Jet Noise Problem

New York—The summer jet noise problem at New York International Airport will become more critical this summer as the "open runway" season arrives at neighboring communities, and at the same time jet frequencies are stepped up by the airlines. Adding to the problem is the hot-weather loss of performance of the jet, which cuts allowable takeoff weights on length-restricted runways.

The Port of New York Authority's Executive Director Austin Toben, subject of a noise controversy last year when he blocked the new characteristics of the Boeing 707-120 (AVT Sept. 3, p. 76), recently protested publicly that jet noise complaints are heavy and that the communities won't tolerate additional noise. Five airlines now operate jets at Idlewild under Port Authority customs regulations including post-vented jet engines.

'Four Record' Airlines

Two of the Boeing 707-120 operators, American Airlines and Trans World Airlines, have achieved a "four record" at Idlewild with the new procedure, according to the Port Authority.

The airport's jet takeoff monitoring from the beginning of last operation

last October through May, 1973, produced these statistics:

Airlines	Number of Takeoffs	Volets time 305	to Volets 40
American Airlines	7	8	9
BOAC	110	7	53
Norfolk	146	46	155
Four Airlines	791	60	57
TWA	171	74	62
Total	2364	494	—

The Port Authority's rules, as originally set up, first prohibited a maximum noise for jet takeoff to get above water instead of nearby communities. When this was amended, it stated that runway exit other than noise must be used under specified operating procedures involving a 1,200 ft runway already over construction, takeoff power settings, flap settings, use of climb power outtake and designated turns. These detailed operating rules have been given recognition by several experienced and the Port Authority has changed its compliance criteria. The runway power system, but after that it is up to the airline as long as the noise level is within the allowable range—i.e., not more than 117 "percent noise decibels" on the

ground in the communities involved. This percent decibel standard is designed to measure noise as the human ear does rather than as a mechanical device would. Developed by Bell, Boeing and Neuman, converted coefficients, it is said to introduce the human response factor into a measurement formula. By the standard, a jet gives a higher reading than a piston plane because the jet noise is higher in frequency and lower noise entering to the human ear.

New Formula Works

For example, a jet at about 1,000 ft over a community might bring the reading on a straight decibel meter to 100 db. Applying the percent decibel formula brings the figure to about 112 db. A piston aircraft would be at a lower altitude than the jet say 500 ft to give the straight reading of 100 db. Adjustments would bring the piston percent reading to about 105 db. The difference is due to the frequency of noise involved, with the jet noise falling higher on the frequency scale. This formula is complicated and the above example is typical rather than exact. Some airline officials have modified decibel percent decibel measurements, but the Port Authority says the

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Lockheed Assembles Northwest's First Electra

First of 10 Lockheed Electra turboprop aircraft for Northwest Orient Airlines is almost completed and is expected to be delivered July 31. All 30 are planned to be in service this year. Northwest will deliver new Boeing 747-200s to Lockheed on a regular schedule. Northwest's Electra will carry 1,800 more passengers than other Electras, total capacity will be 4,000 gal.

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standards is being accepted by aircraft experts, aircraft manufacturers and others concerned with noise abatement.

Maximizing System

The Port Authority's mission jet takeoffs by sending a signal crew in a streamer wagon carrying monitoring equipment to check points off the ends of runway near neighboring runway areas. The crew, advised daily of planned engine training and scheduled jet takeoffs, sets up its microphone and records noise levels. The tape goes to a noise in the control tower where a spectrum analysis is made and the perceived noise formula applied. The information, along with flight data, is sent to the Port Authority experts who calculate it and advise the airlines daily as to how this noise is being handled. "Violations occur when the wrong runway is used and/or the reading exceeds 112 perceived noise decibels."

The Port Authority, in its latest (first 5) effort to maximize system available in the Idlewild noise problem, reported that all jet operations had assumed their conventional schedule in May, compared with April, when Runway 28 was out of service for construction of "airline service irregularities." But American and TWA "continued to make" poor records of compliance for the period from the beginning of June jet operations through May 11.

American and BOAC operate the 40-100 ft. Class 4 and have been problems with the procedures with that smaller and lighter aircraft. National is out of the jet business temporarily, its leased T712B leaving gone back to Pan American, so only those airlines actually have a noise problem this summer.

'Cooperation' Where Possible

Both American and TWA adhere to an official line of "cooperation where possible" with the Port Authority, and both are aware of the requirements were guidelines. Cooperation "where possible" officials agree when consistent with safety, but it seems clear that the increased landing is more consistent with safety and common. "Notable" about especially is going to service gate load or make a last stop to refuel the Port Authority rules.

For American, on the other hand, one of its first landing was scheduled to follow the procedures and the record would have been set.

United Airlines, American's regional or carrier office action at Idlewild has left a commitment within its own administration to complete possible alternative means of handling the noise problem.

In effect will be to find some way of keeping the community accep-

tion down without punishing the airline companies of the expense and impact for jet transport.

The airport FAA office recently contacted American Airlines to remove from its jet flight schedule the portion dealing with continuous sound taking patterns. American's pilot training did not incorporate the procedures spelled out in the manual and FAA put the airline at a disadvantage of receiving them from the manual or making the training consistent with them. American took them out. In its letter to American on the subject, FAA had no impact management can impose its procedure that might detract from passenger safety.

and that American should advise FAA of all operations required wherever it is written by airport management.

Meanwhile, the Port Authority says it is aware fully concerned that not that the jet noise problem is serious of severe terminals around the world.

Consequently, complaints at Idlewild the Port Authority has, one of a different kind now. Jet complaints come, more often directly to the airport, from ownership leaders who felt that the Port Authority's attitude toward jet operations would protect them from excess noise but who now are disappointed.

The complaints are difficult to raise.

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in terms of volume. The Port Authority profits not in providing services on the number of complaints and National Air Transport Coordinating Committee, aviation industry food and drug administration, qualifies the statistics as considered it in New York complaint center.

"Our complaint center does not receive all aircraft noise complaints," NATCC says. "Most people prefer to register their complaints with various forms of their organizations as with their local law enforcement agencies and/or with their political leaders. Other complaints to government agencies, the airport operator or to individual airlines."

NATCC's records show a total of 61 complaints concerning 180 flights operated from April 1 through May 7, 1978. That for the same period last year was 321 complaints, of which 21 were the result of 946 takeoff operations. "We have yet to experience a volume of scheduled turbulent operations during hot weather," NATCC says.

Arthur J. Fallon, Port Authority Deputy Director of Justice, told Aviation Week he believes the airlines are going through a phase of getting used to their jets and that the situation will improve as techniques are perfected. "I don't believe this thing will go on," Fallon said. "We are convinced that the airlines in the final analysis are going to be with us as this as a reasonable airline will take a public-hearing attitude over a long period of time. We're doing our best to explain over and over again to the airlines the seriousness of the thing."

PanAm Expands Its Hotel Subsidiary

New York—Pan American's hotel expansion may be doubled within the next two to three years in an expansion program designed to meet part of the need for more facilities to handle prime tourists and business travelers.

Now involved in acquiring 15 hotels in Latin America and the Caribbean are Intercontinental Hotel Corp., a wholly-owned subsidiary of the airline, is looking at sites in large cities around the world and expects to begin construction in Europe and the Far East. The company already has an interest in a hotel at Beirut, which has been under construction on and off for four years but has been delayed by political and economic problems. There have been reports that Intercontinental Hotel Corp. was negotiating for a hotel in Vienna, but the company says nothing definite has been worked out in that city.

Recently, Intercontinental Hotel Corp. provides technical aid in plans



ROAD MAPPER FOR THE X-15

Texas Instruments roof prism share a vital role in mapping a safe landing course for the first manned space craft. Installed in a photographic system aboard a Douglas A1D-2P, these prisms recorded landmarks that will guide the X-15 pilot in his return to earth. Accurate photo mapping at 600 miles per hour requires exceptionally high quality optical components. This roof prism, for example, has surfaces that must be held within seconds of arc, difficult to manufacture! Not for TI craftsmen... telescopes such as these are not everyday at TI in production quantities.

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powered subsidiary; Sterling-Cutler, for nuclear instrumentation; General Atomic, for Tegra research reactors; Liquid Carbonic, for production of industrial and medical gases; and Raychem-Durham, for the production of electro-mechanical control equipment.

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using conducting financing and using hotels as main control in the Americas. Most of the arrangements are through loans or management contracts, but the hotel company once took on all the hotels and a controlling interest in four of them. Last week, International Hotel Corp.'s net profit after taxes was \$219,000. Four years were already affected by political conditions in the Caribbean. In 1977, profit was held in \$249,000 by actual expenses in opening several new hotels. The 1978 profit was \$477,000.

Two new International Hotel Corp. hotel interests were completed last year, one at San Juan, Puerto Rico, and the other at San Salvador. In addition to the hotel facilities, a hotel at Pinar, Puerto Rico is still under construction. Hotel management of the company's hotels exceeds \$60 million.

For American hotel companies was set up in 1946 and its first hotel, the Grande in Lima, Peru, was opened in 1948. According to International Hotel Corp. American studies showed a growing position for hotel facilities in South America but existing hotel up in area were subject to be started.

Position of such needed facilities stimulates an hotel, International Hotel has found. As an example, the company's hotel, Tegucigalpa, in Tegucigalpa, Honduras was started in 1973. In the year after its completion, the number of international air passengers through the city more than doubled. Because at this hotel area, more than 10 million a year and the hotel is being expanded to a 100 room capacity.

The hotel expansion is under the overall supervision of Pan American Vice President Roger L. Linn, but only a division of public relations is a Pan American employee. There are about 5,000 employees in the corporation. About half the managers in the hotel are U.S. citizens.

Financing is one of the operations of International Hotel Corp. again was plan, according to Richard E. S. Douglas, executive vice president. Public relations are of a business interest, Douglas told "Business Week". Financing comes partly through local governments through local financial groups, and through International Hotel Corp.

In some parts of the world, Douglas pointed out, hotel accommodations are poor in non-urban areas. Since the jet transport will have no really out of the way places, facilities will have to be developed to accommodate tourists looking for new spots. And advancing economic development of some countries will also bring a need for some making more business hotels.

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Riddle Argosy Makes First Flight

According to Westland Aviation, the first of four ordered by Riddle Airlines (NW April 6, p. 45) makes its maiden flight at Luton, Bedford, England. Aircraft is powered by four Rolls-Royce Dart 800 T2 engines delivering 2,100 hp each. The Argosy was on display at the Paris Air Show; military version has been ordered by RAF.

Developer said, will be of 200 more or more.

In addition to the hotels mentioned above, International Hotel Corp. has projects in hotels in Chile, Calcutta, Ypres, Madrid, Manila, Mexico City, Buenos Aires (Colombia), Cuba and Uruguay.

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British Government Rejects Helipoint

London—Proposed by Rotoparts Ltd. to build a government helipoint on the Thames to serve central London has been rejected by the government.

Announcement of the decision declared the site was unsuitable for a helipoint because the noise of helicopters arriving and departing would disturb people living on the opposite bank.

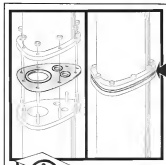
The decision is viewed as the opportunity of providing London with a central helipoint if no one to the public has been turned down a similar move by the company, said. The decision will be challenged on every available ground and method, he said.

Australian Overseas Air Traffic Increases

Melbourne, Australia—Considerable increase in international passenger traffic, coupled with a comparatively small overall decline in domestic traffic, marked Australian air transport activity last year, according to Sen. Stuart Paterson, Minister for Civil Aviation.

Australian international airlines carried 38,857 passengers in 1958, an increase of 11.7% over the previous year, total of 405,000, 200 passengers were on a 14,000-hour. Extension of Qantas service through the U.S. to London resulted in a 77% increase in seat miles available.

Domestic traffic dropped 1.1% in 1958, for a total of 1,148,954 passengers. However, passenger figures for the first quarter of 1959 show domestic traffic up 5.5% in January, 5.5% in February, and 14.7% up in March.



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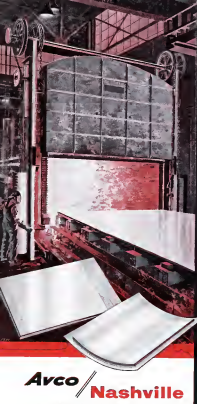


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In this furnace the Nashville Division will make both contoured and flat panels up to six feet wide and 26 feet long.

Already two smaller furnaces are turning out small panels for the high-speed aircraft of the 1960's, as well as other important components requiring high resistance to heat and a very high strength-to-weight ratio (see characteristics of Avco's). In a few more weeks, the Nashville Division will announce even more production capacity for Avco's through new and less costly processes than those now generally known to industry.

Both the Nashville Division's engineers and its management believe that Avco's state-of-the-art honeycomb will be the secret of its future that shines in to today's aircraft. And like aluminum in its early years, Avco's will find its way into every new, and as yet unforeseen, application.

Anticipating Avco's prospects, Nashville Division engineering already is looking into new and challenging applications for its complete design, tool, and build capability for state-of-the-art honeycomb. Several such applications are now under investigation. They range over a broad area, from armored structures for military vehicles to air-droppable bays.

For more information about Avco and the Nashville Division's design, tool, and build capability, write: Marketing Manager-Structures, Dept. W-69, Nashville Division, Avco Corporation, Nashville, Tenn.

Rocket-Jet Mach 3 Transport Proposed

By Glenn Gorman

St. Louis-Rocket, engine and two-stage vehicles are possible possibilities for supersonic commercial transport. A meeting of the American Society of Mechanical Engineers was held at their recent annual meeting last week.

Among the two-stage aircraft approaches for high Mach number and/or operation proposed at ASME's aviation section were:

- Use of a 180,000-lb thrust liquid propellant motor in combination with afterburning turbojet engines for take-off, climb and acceleration of the super-sonic transport. Rocketdyne Division of North American Aviation said the rocket engine could be used in the S-1, two of which are used in the first stage of the Atlas circumnuclear ballistic missile, in two of the four in S-5, one of which is also used in the Atlas and which would provide about the same amount of thrust.

- Combination of turbojet engines for take-off and cruise which would heat the climb and also use turbojets during the cruise regime. Advantages would be low operating cost, high reliability, fuel savings and less danger from engine failure at high altitudes.

- Two-stage system in which an acceleration aircraft takes a cruise vehicle to altitude. A major advantage claimed for this concept is that it permits a smaller aircraft to carry passengers into low stages of high speeds. Examples and the future in airline operation would be expected to result from this approach.

Rocket-Turbojet Combination

Regarding the use of the motor engine in combination with turbojets, J. M. Cummings, Rocketdyne's program manager, said engine systems could be used in the second stage of the rocket engine. But for climb and high altitudes in cruise speed, rocket engines would be advantageous. Cummings said his company's development of second stage engines under a Navy program, including the AR-1, which significantly boosted the speed and altitude performance of a North American F-107 aircraft in flight tests.

Use of major engines for supersonic cruise would save 20% in size and direct operating cost over the single-turbojet, according to J. F. Davis and E. G. Smith of Rocketdyne, Aerojet Co. Design of a transport with such a type of powerplant to do the three jobs required during take-off, cruise, acceleration and cruise involves serious

compromises, the Rocketdyne officials said.

Take-off weight of a Mach 3 transport with 100-passenger capacity and 5,000 tons take-off weight would be about 200,000 lbs with the turbojet engines mounted on the wings with the single type of power plant, or twice of fuel weight. The rocket engines would save 15% of gross take-off weight, most of that offsetting three own weight which would add 25% to the gross. Since payload is the aircraft at only 17% of the gross, the 15% weight saving would mean a 10% weight and payload gain by 19%. And for the same payload, overall size of the combination aircraft would be 35% less.

A safety warning claimed for the rocket engine was that in case of failure in high-speed, high-altitude flight, ion-stored kind components of the engine are not as sensitive to fuel and oxidizer leakage as the turbojet engines and turbojet is the turbojet. And vibration levels are at a minimum in the rocket. Above Mach 3.5, according to the Rocketdyne officials, the rocket engine is not as sensitive to vibration as the turbojet is a serious headache, since high temperatures and stresses produce a hazard and a maintenance problem.

Manufactured facilities now being used for development of supersonic transport engines, the officials said.

The two-stage supersonic transport system proposed by Applied Science Laboratories, Inc. and its associate engineers other projects such as that of British Satellite Engines, Ltd. (AW May 11, p. 40).

Walter Douglas, Lewis Fildes and Ernest A. Stokowski of Applied Science Laboratories said the two-stage system would show a third test but there would be a serious problem in the case of the first test. The first test would be used over a 1,000-foot test rig.

Operational flexibility was said to be provided by the fact that an engine could run the two-stage system on water that met low ground clearance between two groups of terminals—for example, between Burton, New York, Philadelphia, Washington or Washington, the East Coast and San Diego, Los Angeles, San Francisco and Seattle on the West Coast. Under the concept, a few landings would be needed to be between the terminals in one group, involving a high number of engine aircraft at high speed operations. A major scheduling arrangement could be made between that on the Eastern Seaboard and other western airports. This system would offer greater efficiency where conditions, traffic patterns, weather and other schedule requirements are appropriate.

One of the cruise vehicle configurations listed desirable by the Applied Science experts was a two-stage test engine equipped with passengers on climb in a rocket engine, and a rocket engine mounted on a cruise vehicle combining an auxiliary engine component. This arrangement was said to provide additional structural support.

Continuing of Rocketdyne, however, expressed the view that the two-stage system proposed might be an operational problem.

Mach 3 Goal

Discussion of supersonic transport development by the Applied Science members centered on a Mach 3 speed objective—at it did earlier this year at an early stage of the American Society meeting (AW Feb. 2, p. 35).

Despite the conventional approach, the supersonic problem discussed above ASME's discussion focused on more conservative concepts of high Mach number aircraft transport.

High-Mach number aircraft transport, however, it was not possible to be relied on because of its inherent just beginning to adjust to its initial use as a subsonic jet engine.

Among the points discussed were:

- Development of the Mach 3 transport has already been built into some problems in coming up with the desired performance, reliability and maintainability for commercial use. One of them, according to G. C. Rapp of General Electric's jet engine department, is that of engine shutdown at Mach 3 speeds. In that regime, there is very little difference between wind tunnel and actual operating speed and it will be necessary to reduce the engine speed to maintain the reliability of the engine. This would be accomplished by a blocking of the airflow paths, possibly combined with a locking system through the associated structure before the engine is shutdown. This would be useful for the emergency landing, and one of the problems this raises is developing a thrust-to-weight ratio compatible with the afterburning concept. One of the biggest problems will be to require the engine system with a thrust-to-weight ratio as low as required. Rapp said this is probably the most difficult requirement to meet now for the supersonic transport and reliability. The compromise in engine performance accepted as adequate for use in Mach 3 design, he said.

Avco
Nashville

• **Environment control** is an increasingly important factor in spacecraft design. Such environmental control requirements and pressure at altitudes of 70,000 ft. is a major design fact, according to Fred A. Ponce of North American Aviation. Low-oxygen air can be compensated for by rate of flow or exhaled through an evaporative water bedder, Ponce suggested. A rate and window rate of 10 is as desirable as possible with moisture control, he explained. Concerning the air traffic control problem when spacecraft transport are introduced, Ponce pointed out that one flight slot was the fact that spacecraft flights would be smaller than subsonic jets and also less vulnerable to wind and weather delay because of the altitude at which they will operate.

STOL-VTOL Development

The varieties of short takeoff and vertical lift-off aircraft under development will need to firm up their roles in the view of L. B. Nichols, Bell Helicopter Corp. official. Three types are helicopters, lifting people, planes, and helicopter-powered VTOL aircraft. The helicopter, as Nichols' view, has not shifted in broad a role to the transport picture as originally expected, having fulfilled the missions requiring heavy lift and transport efficiency. Of the other types, Nichols said the lifting design fills the broadest area of the spectrum between having ability and forward flight ability. With suitable hovering ability and reasonable transport efficiency, the lifting can

be applied to mass civil transport, bus, mail, and military missions. The helicopter, in his view, is the most effective for short range transport, firing craft and rescue military tasks. The tail rotor VTOL will move long distances and other missions, he believes, because of poor hovering performance must be geared to suitable landing runs.

Some discussion of options was captured by Claude E. Lebedevsky, Bell Helicopter engineer, who said both of Bell's XV-3 lifting, hovering helicopter is a practical design for both helicopter and airplane configurations.

Lebedevsky reported that 14 full missions with the XV-3 have been made by the Bell test pilot and three conversions by an Air Force test pilot. The conversions have been made in steps and conclusively at scheduled altitudes between 80 and 116 ft. and at altitudes from 5,000 to 10,000 ft. The time required for a continuous two mission is 12 sec. The first complete flight profile cycle with the aircraft was completed in April. An appreciable loss of altitude accompanied the complete initial climb cycle but this will be reduced by improved technique, and stabilization of low forward speed engines will provide an altitude increase as rate time is decreased.

The Bell official said control and stability of the XV-3 during forward flight and in normal maneuvers at altitudes greater than 25,000 ft. are satisfactory and positive. During hovering and low-speed flight behavior, added speed control and improved stability are desirable for use between down

draft and the division of responsibility and what legislative measures, if any, are needed.

• **What changes are needed** in the existing statutory provisions relating to substance to procedure to enable the transportation and other missions, he believes, because of poor hovering performance must be geared to suitable landing runs.

A major portion of the discussion centered around the topic on what committees should be taken to possibly attempt to influence congressional members or engineers. Airline attorneys blamed Congress still for much of the "major problem" imposed upon the Board.

Bell's complaints were registered with the committee about engineering and technical issues in light of technical points of civil components before the CAA without prior notice to the opposing side and with no time limit set on references.

Suggestions offered by participants included:

- **Board members** be given freedom from making appointments to be increasing the present member from 10 or more and that they be barred from appointment. In addition to longer terms, better salaries and a good pension should be provided to an effort to attract high quality persons.
- **All private communications** between the staff and the Board and between constituent parties and the Board be made a part of the public record and the use decided on the basis of the complete record. Confidential, confidential communications should be kept confidential in any one case are made in the Board's public files, but are not considered so the document is made a part of the record.
- **More** terms commences should be appointed and they should have technical assistance provided should be increased and higher standards set for the selection of nominees.
- **Board members** be given the power to impose civil penalties for violation of aerospace regulatory provisions of the Civil Aerospace Act to prevent a last-minute withdrawal of a nominee to fit the nature of the industry.
- **Board should be given authority** to eliminate the requirement for a hearing on certain cases involving subcommittee or certain cases involving subcommittee or certain cases involving subcommittee or certain cases involving subcommittee.
- **Air carriers should be exempt** from filing contracts and agreements with a contract and cases between carriers in a suit as a public safety matter in an aspect or point use at a place of transport.
- **Modify and clarify** the position of the Act relating to the Board's exemption from suit or not exempting any carrier could be modified under suitable conditions and the Board's position could be modified under suitable conditions.

Next Decade in Space Special Report on NASA Programs



BOOST-GAIN vertical lift-off up to suborbital speeds (right) foundation laid by National Advisory Committee for Aeronautics for space projects of its successor, National Aeronautics and Space Administration. Model, shown vertical lift, is proposed for test in Lewis Research Center propulsion wind tunnel. Some models of such units may have flat tops, forebody booms.

NASA Leads U.S. Venture Into Space

Man is standing at an intellectual vantage point now in his history, from which he can foresee revolutionary changes that have not yet taken place.

Harassing the easy access to take his mounting requirements and

but human history has placed man space has opened a field of exploration so vast that his ultimate, of its potentialities clearly is expanding in the way the universe itself is thought to expand.

The universe has become a better known, better understood, and a more certain, where new knowledge, no longer in the shadow of imagination but of discovery. The universe, long a realm of speculation for man's mind, will become a realm of exploration at least by the mechanical devices that extend man's sensory powers and perhaps for man himself.

The greatest promise offered by this new frontier is the possibility that man can learn how his nature, by solar winds, his planet and his life began, and whether life of the same or another sort exists elsewhere in space.

In carefully the condition and pay towards the understanding of these circumstances and discoveries will involve

and effort all men but the execution must have a more modest beginning.

The two largest nations of the world are engaged in major programs to lead outspace and understand the secrets of nature as they are revealed in the laboratory of space, and to extend the frontiers of life on earth to other planets.

This undertaking in the United States is being led by the National Aeronautics and Space Administration in the hope that the exploration of space can remain a peaceful one. In this it cannot the program is closely related to and supplemented by military programs.

The U. S. space program has become a truly national one, involving thousands of persons in all scientific and technical disciplines, in the professions of education, law and government, in rapidly growing portions of business and industry, and indirectly involving agencies through the support of its citizens.

Immediate goals of the program are to learn more about the earth, the atmosphere that makes life possible, earth's natural satellite, the moon, the closest planet, and whether man can exist in space.

Ultimate goals are to learn and understand all there is to know and understand about mankind and his environment and their secrets and destinies. If these goals are attainable, they seem far less so than they did even a decade ago, and that area at least looks strongly of attainment that a great effort is being put into pursuing them.

Programs, Plans, Goals

Administrator T. Keith Glennan has said that NASA's work can be divided roughly into programs, long-range plans and objectives. Its programs are mapped out somewhat in detail for the next three years, more considerable work already has gone into preparation of the fiscal 1964 budget, which will set the agency's activities through June of 1962. Long-range plans are evident in 1962

Durfee Cites Heavy CAB Workload

By Paul Eastman

Washington—Extension of legislation to increase Civil Aeronautics Board membership is one the workload imposed by James B. Durfee, CAB chairman, while testifying before the House Special Committee on Legislative Oversight last week.

He said decisions concerning administrative process problems before the committee, Durfee said he thought left the present five-man board should be increased to seven or nine members.

"By deciding whether an administrative matter presents," Durfee said, "the members are facing an almost impossible workload—and the Board has a very different time operating with nine members of three different types, one member is delegated to unscheduled negotiations, some accident hearings, embassies with other agencies, or even when foreign states."

"He said the Board is able to discharge its duties only by extensive reliance on liaison among members con-

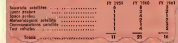
ducted through their personal assistants and by extensive use of short-cut procedures.

(Rep. Orr Harris (D-Ark.) committee chairman, introduced the legislation for the purpose of gathering views on regulatory agencies problems and what legislation, if any, is required to overcome problems and stresses the effectiveness. Board members besides Durfee were members of the CAB staff advise members to and providing advice statements.

Types for discussion were:

- **What** legislative or administrative measures have been or should be taken to provide adequate assistance in reference case members or employees by means which do not afford a false opportunity to subvert the law.
- **What** is the role of hearing committees, their present strength and weaknesses, and what amount should be taken to increase their effectiveness.
- **What** is the role of commissioners and their immediate staffs and agency

Tentative Vehicle Launching Schedule



line from the H-bomb infrared space booster program. Even excluding the probability that nuclear power and possibly even controlled fusion power will be available by the end of a decade, the booster program focuses launching of nuclear spacecraft in the interim.

Penetration of the future level on perspective of technological progress efforts have focused out to be overwhelming about severe events and cycle conservative about what would be achieved over a long period of time.

Whether man will be able to visit the end of a decade is a matter for speculation. Study and planning already under way at NASA is based, however, on belief that he will eventually be able to do it. If the administration, less and that "in the near future the required technology, we will send an expedition to the moon and later on to Mars, to Venus, and to more distant reaches of the solar system."

Scientific Objectives

Scientific objectives of the NASA program—which, until now, concentrates on planetary and planetary considerations—are the most important. The scientific program's existence, has been quite clearly spelled out. They are as follows: (1) man's curiosity demands that they be, and they will be pursued for many decades to come.

NASA said that the "space program" is a broad-based program for scientific investigations carried out in space by means of sounding rockets, space satellites and space probes.

It has divided its space program into seven basic areas for investigation, as though they obviously are overlapping and interrelated. These are (astronomy, cosmology, geophysics, planetary science, and magnetic field, geophysical fields, astronomy and bioastronomy).

In program for investigating these areas are assigned a little differently, roughly in the type of tools that will be used to explore the scientific systems. A brief look at this second type of breakdown (themselves the direction NASA is taking and indicates the kinds of vehicles available for the job).

• **Space probes.** Beyond the astronomical vehicles such as the Juno II, Thor-Able, Atlas-Able and Thor-Deja, NASA has begun work on those that will be the workhorses of the space program for

the next several years. They include the Vega, which will cost \$91.6 million over the next four fiscal years, including 1964, and the Gemini, which will cost \$95.5 million over the same four years. Vega's mission will include deep landings on the moon and orbiting of a two-man space laboratory. Gemini, an advanced manned vehicle, will be used in 1961 and also will launch communications satellites and point out landings on the moon.

Still further along are the 1.5-million lb thrust engines, the next step, that will permit manned lunar landings and, logically, orbital space laboratories. Somewhere beyond that, estimated at eight to 10 years off, is the nuclear rocket engine for which NASA is providing \$8 million in fiscal 1960 and the Atomic Energy Commission, \$46.3 million in fiscal 1959 and 1960. No plan phase program for use from earth orbits may precede the development of useful nuclear engines.

• **Sounding rockets.** In addition to planning to fly some 100 sounding rockets in fiscal 1960 and a like number the next year, NASA is working to develop a vehicle design that the sub-orbital Soviet, for high out to several thousand miles. Sounding rockets already have penetrated an atmosphere with a factor of three in the form of what short, some instruments will be made for the next several years.

• **Scientific satellites.** This category includes development of an orbiting astronomical observatory and an attempt, still pending to test it, part of the general trend of scientific programs discussed more with this type of outstanding tool already discussed in the Vega and Gemini vehicles. In the case of the one about 200 mi. in orbit, it is said that it had been believed, which means that spacecraft will require more thrust to maneuver in this region.

• **Lunar probes.** These are to be launched in fiscal 1960, with two intended to launch on the moon and the third intended to orbit a few hundred miles above the surface. Soft landings are scheduled for 1961, to test the first lunar satellite, and thereafter on the moon. The data obtained will lead to the design of vehicles for manned landings.

• **Deep space probes.** Two of these, scheduled for late fiscal 1959, probably

will go over into fiscal 1960. The 1960 budget allows for preparation of two space probes to be fired in fiscal 1961. At least one will be fired toward Venus.

• **Meteorological satellites.** Two attempts will be made by mid-1960 to launch a first balloon satellite. More sophisticated television weather satellites, called Tiros and advanced from Defense Department, are to be launched late by the end of the year and another next spring.

In 1961, two launches of a prototype operational weather satellite into a 700-mi. polar orbit, using the Vega rocket, are planned. The program will continue over the next two years. The 1960 meteorological satellite funds.

Steps toward the use of solar orbiters and experiments leading to an advanced operating system that would be an orbiting, in 700-mi. polar orbit, and four in 22,000-mi. "diurnal" orbit.

• **Communications satellites.** By the end of 1959, a 100 lb inflatable passive reflector satellite is to be launched, followed by a manned experiment between the east and west coasts.

In 1960 and 1961, three more launches are planned. One will carry a number of instruments in an altitude of 7,000 mi. The probable use is a Vega carrying 30 collectors.

• **Manned space flight.** Beyond the two-man Mercury manned capsule, the plan for a two-man capsule, an orbiting station laboratory, and a station of the agency of Mercury and the question of man survival, only a small percentage of the next budget has been reserved for the station of future manned craft.

Objectives of the NASA program range far beyond these projects that are not enough to have feasibility and research associated with them. The study program for space program is a study of some dramatic satellite and space probe launches, but it is the very broadest kind of framework, within which all NASA's other space work is done.

Dr. David has expressed the implications of this search for knowledge that may.

The most profound aspect of space knowledge will be on the basic science of astronomy and geophysics. For space vehicles could provide direct experimental measurements in space at the site of the phenomena under study.

Through advances in these techniques, we will gain a deeper understanding of the universe in which we live, including on earth and nearby space, the moon and planets, interplanetary space and other planets.

"This deeper understanding and knowledge will bring the power to predict, to direct and to control the forces of nature and our own destiny."

Engines Hold Key to Space Timetables

Five new liquid fuel rocket engines and modifications of two existing engines of the same type form the backbone of the national space program as now planned by the National Aeronautics and Space Administration. All very large space vehicles scheduled to be launched by NASA in the next five to six years and probably within the next 10 years will be powered by combinations of these seven engines.

Extreme importance of these thrust engines around the fact that they are the largest and thus most acquired for the space program. Their development and successful development is one of the U. S. is to have an engine of matching Soviet Russia in payload capacity in the near future of sending manned vehicles to the moon and beyond.

The efficiency of these engines and vehicles which are tailored for specific tasks, will be much higher than that of the modified military rocket engines in use. They will deliver the thrust most required to send a pound of payload into orbit at one-tenth of the earth's gravity by as much as 20 to 30 times.

Soviet Propulsion Lead

NASA estimates that it will be about two years before this new engine program will bring the nation's space-launching capabilities to the level the Russians claim to have. This engine is being developed by the Soviet Union, but the U. S. booster power will jump again after that point if the present schedule can be maintained. Depending on Russian progress, there will also be some changes in long-range space in space cooperation.

Several other projects in the NASA propulsion program are involved either with solid fuel rockets or with gas turbine engines. These include: (1) a new advanced program that will be in the research stage. Solid propellant work programs is concentrated on the next rocket which is now in its initial phase. Its purpose is to develop a long-range vehicle of improved rockets that can carry 100 lb of instruments into a 1000 mi. or 1000 lb. to an altitude of about 1,000 mi. Soviet will be the most expensive rocket system for space work in the U. S. inventory.

Large nuclear powered rockets and chemical rockets, high specific impulse rockets such as ion and plasma rockets are in an advanced study stage.

Present opinion is that ion rockets will reach development first with light ion possibly taking place as early as five years from now.

The seven liquid fuel engines that are due to receive the bulk of NASA's development funds over the next five years are:

• **6,000-lb thrust** flexible fuel engine

being developed by NASA's Jet Propulsion Laboratory. Although let operation times are difficult to estimate accurately, NASA now expects this engine to be available in fiscal 1960.

• **35,000-lb thrust** engine using liquid hydrogen and oxygen propellant. This is being developed by Pratt & Whitney Division of United Aircraft Corp. Operational capability is expected in 1961.

• **38,000-lb thrust** flexible fuel engine which is still in the study phase. Scheduled to be available in mid-1961, this engine can use a pumped liquid propellant rather than the pumped liquid tanks of the 6,000-lb thrust engine.

• **38,000-lb thrust** liquid hydrogen and oxygen engine, which has been under research and development contract for about a year. It is scheduled to be available in the first quarter of 1961.

• **1.5 million-lb thrust** single chamber engine using kerosene and liquid oxygen propellant. This engine is being developed by Rocketdyne Division of North American Aviation Inc. and is scheduled to be available in mid-1961. Air Force and Advanced Research Projects Agency separately supported this work.

• **14,000-lb thrust** engine which is a modification of the first stage engine of the Vanguard rocket launching satellite General Electric Co., the contractor for the staged engine, will handle the modification. The new engine is scheduled for flight test in mid-1960.

• **100,000-lb thrust** kerosene and liquid oxygen engine, a modification of the type used currently on Atlas and Saturn rockets, has been scheduled for flight test of these engines for the single-stage Saturn rocket.

Primary objective in the selection of these particular engines is to provide a family of space vehicles with increasing capacity and reliability. Each vehicle in the family should be able to carry out most of the space missions planned during a two to five year period. But missions would cross over into work involving low and high orbit orbits, long exploration, planetary exploration and deep space.

The ground-purpose nature of these



NEW engines are under development for modified space boosters or vehicles to launch test vehicles. The four-engine Jupiter second stage, Atlas and Titan 340 are also space.

• NASA Report

vehicles would allow them to be used over broad and at frequent intervals. As a consequence their reliability, which is the most outstanding requirement for space use, would almost inevitably reach a high figure.

Two systematic families of new vehicles, the first of which will be ready for use in about one year, will eventually replace two groups of vehicles. One, which exists now, includes the Navy-Martin Vanguard, Army-Corpler Jupiter-C and Juno II, USAF-Space Technology Laboratories Thor-Able and USAF-Lockheed Thor-Hunter. With the completion of the Vanguard all of these vehicles originally had sweet retro-tare backgrounds. Most powerful is the Thor-Hunter which runs a Bell Aircraft Corp. Hunter rocket engine, originally designed for a Convair B-58 bomber pod, in a second stage, for the Douglas Thor IRBM.

Thor-Hunter is the primary vehicle in the Dorsum missile series being conducted by the ARPA. This group of boosters, which has been the heart of U. S. demands in space created by Sputnik I, has met seven satellites into orbit and launched three space probes.

The second group of boosters that will be superseded in time by the new family of NASA vehicles are two main families of the USAF-Corona Atlas missile and one variant of the Thor-Able, all of which will be available within the next year.

One is the two-stage Atlas-Hunter, using the Bell engine for the second stage on the Atlas, which can put 1,000-lb. in a low orbit. The other is the Atlas-Able, which uses the Aerojet second stage of the Vanguard and an Allagay, Bell-Lockheed solid engine mounted on the Atlas to make a three stage vehicle. The last of this group is the Thor-Delta which is the Thor-Able with guidance added in the second stage to allow it to coast for considerable distances after the first stage burns out. Coasting guidance of this type allows the vehicle to place a satellite into a circular orbit of considerable altitude by firing its second stage at the proper angle when its maximum altitude is approached. Coasting capability also will be useful for space probe missions. A dozen Deltas have been ordered from Douglas.

Four Basic Vehicles

Four vehicles are now being planned by NASA to use the seven basic engines being developed in the new booster program. The first to use Atlas for the first stage, but they will have a much greater payload capacity than the Atlas-Able and Atlas-Hunter because the upper stages are designed especially for the Atlas, so that all stages are properly matched from a weight and power standpoint.

Atlas was chosen for the primary stage of these two vehicles because it is

the largest high-thrust booster assembly available in this country. Its reliability during the last year has been "outstanding" according to the NASA, and it is considered by that agency to be the ideal building block to get great payload capability.

The four advanced vehicles are: • **Vega.** This vehicle, being developed by Convair Division of General Dynamics Corp., will come in both two- and three-stage versions. The first stage will be a production type Atlas except that the front end will be brought out to a full 10 ft. diam. so that the propellant sections will be completely cylindrical. Second stage will be the same diameter. It will be produced with Atlas tanking and will mate with Atlas test and launching equipment. This stage will use the modified GE Vanguard engine. This was the most successful of Vanguard powerplants and it functioned properly on its last six flights. Major modification in this engine is an increase in nozzle length and addition of an injection system for attitude steering. NASA expects delivery of the first modified engine late this year. The two-stage version will be able to put roughly a 4,000-lb. payload with several men aboard into a 500 mi. orbit for orbital work. This second stage engine will also have a coasting capability so that it will burn during two different portions of the flight. This capability is needed to place objects

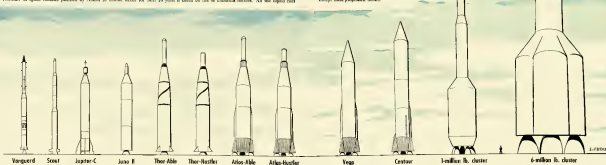
as cosmic shots up to 24,000 mi. Vega's third stage will be the 6,000-lb. thrust storable engine being developed by the Jet Propulsion Laboratory. This stage will be required for lunar and interplanetary probes and its nitrogen tetroxide and hydrazine propellants are designed to be ignited near the target planet some days after leaving the earth. First firing of the two-stage Vega are tentatively set for mid-1959.

• **Centaur.** This vehicle will be the first to use hydrogen, the lightest of all fuels. First stage will be a modified Atlas. Second stage will use two 15,000-lb. thrust liquid hydrogen and ion engines being developed by Pratt & Whitney. The new 6,000-lb. thrust storable engine planned for Vega will be used in the Centaur's third stage when the mission requires it.

Centaur will be able to perform all the Vega missions but with 50 to 100% more payload because of the high energy second stage. Centaur, for instance, will be able to place a minimum of more than 8,000 lb. in a 350 mi. orbit. The superior capability of the Centaur will be based on research and development work that predicts the space boom in a considerable period. Groups who financed exploration of the problems of using liquid hydrogen for rocket as well as weight fuel prior to 1946 included the old National Advisory Committee for Aeronautics, the space agency's predecessor—the Air

except solid-propellant boost.

FAMILY of space vehicles planned by NASA to handle needs for next 10 years is based on use of chemical rockets. All use liquid fuel



Manned Orbital Flight Is NASA's Top

Project Mercury is the highest priority program now being conducted by the National Aeronautics and Space Administration. Its objective is to place a man in orbit around the earth at the earliest possible date. NASA officials have described the program in expert and laudable terms as "being pursued with great effort."

A special NASA unit, the Space Task Group headed by Robert R. Gilruth, was given the responsibility for Project Mercury last Oct. 4, less than a year after the agency itself was formed. It was given not only the challenge of achieving manned orbit in the shortest possible time, but almost unlimited resources.

The technical policy adopted by the task group is to use existing technology and proven methods throughout the Mercury program to save time and money. Although this shortened the need for new research it has not been possible to use all the staff equipment and systems in the Mercury capsule.

New life support and control systems, for example, will be designed along the lines of existing proven systems in aircraft and missiles but they still will require considerable development testing.

It has been possible, however, to make major borrowings throughout the program—the Army-Crosby Rocket and

Jupiter boosters and the Army Thrust Augmenter rockets will be employed during the sub-orbital mission and its manned tests of the capsule and the USAF-Corvus Atlas freely will propel a capsule into orbit.

Efficient production of the total cost of the program, now around \$200 million, NASA will not discuss the Mercury timetable or the date on which it hopes to achieve the first manned orbit because there is no way to predict how long unaided test programs will last.

Unofficial estimates place the first manned orbit about two years in the future, but there is a number of reasons for believing that this may be a conservative estimate.

A delicate spirit has developed among project personnel. This might be regarded from a group that has been given a clear-cut, unambiguous and commanding objective and the means

needed to accomplish it. Mercury has the added incentive of being scheduled in a time against space that its own schedule. There is great haste among the task group that they will be the first to orbit a man, even though Soviet Russia claims a significant lead in the development of a manned capsule.

Although project leaders will not reveal these timetable, there are that the program is on schedule and there have been no delays to date. A strenuous work, perhaps has involved with virtually all of the project's technical personnel voluntarily working nights and weekends.

Mercury's record of accomplishment to date is impressive. Specifications for the capsule were established and mailed to prospective bidders 38 days after the Space Task Group was formed. This rapid handling of a difficult procurement design job was made possible by a broad background of capsule studies conducted particularly—most of them after the first Sputnik launchings—by the Air Force, its contractors, and NASA's and the National Aeronautics and Space Administration.

Still, the task group did not

Priority Task

additional time deciding a batch of major possible configurations would be available the final decision. A NASA spokesman has described the Mercury design philosophy this way: "There are a lot of men to do this particular job but we wanted to find down quickly what we wanted and get going."

As a result the specifications sent to prospective bidders were much more detailed than will be used in NASA projects. Proposals were due seven weeks after the specifications were issued. Oral presentations were made by bidders during the Christmas holidays and NASA awarded the McDonnell Aircraft Corp. on Jan. 5 that it had been chosen to build the capsule.

Technical management of sub-orbital and orbital tests is handled by a number of panels composed of representatives of contractors involved in such tests. For instance, one panel within the Army Ballistic Missile Agency, Mr. Donald and NASA tracks almost daily to make the decisions that compromise necessary to integrate the capsule and the Redstone and Atlas rockets. This panel will also see the seven Mercury space pilots on 130-day ballistic flights.

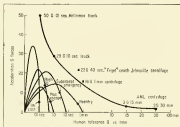
Similar panels control the progress of the orbital schedule. Top NASA officials advise the industry to coordinate these panels but to date this has been done only on a few points. The shortest daily panel meetings have eliminated many interdependencies and produced answers to technical problems in a minimum time.

Firm Technical Foundation

All aspects of the Mercury program rest on firm technical ground. While a great deal of engineering design and environmental test work has yet to be done, the program has been outlined clearly by the wide experience gained in recent years on the major problems associated with orbital flight.

Reliability of high liquid fuel rockets essential to the program is high today and increasing steadily. NASA's Atlas and the Redstone are highly reliable and skillful for training the pilots for ballistic flight. It also expects the Atlas to have reached a high state of reliability by the time the capsule is ready for orbit.

Tests of the human body to the rigors of stresses expected in sub-orbital and orbital flight have been well established by medical research except for certain reactions to prolonged weightlessness. This is not expected to be a serious stress on the basis of present studies and experiments in short duration flight. Radiation, extremely moderate and other possible hazards in the low-



DYNAMIC tests in which Mercury pilots will be subjected have been explored thoroughly in balloons. Photo also will test capsule in sub-orbital flights before orbiting.

altitude Mercury orbit are not expected to affect a human passenger, based on existing and sounding rocket data.

It is now known that in different orbits about the earth the basic technical approach outlined, NASA has backing.

The best method required for the capsule to enter the atmosphere, it being parabolic in both altitude and horizontal lines. While a great deal of some investigation for the ballistic program is applicable to the capsule, the Redstone test has been made from an orbit. Orbital re-entry occurs at speeds with slightly higher than water-contaminated speeds, but the capsule that can be designed to heat or drag is considerably higher and the re-entry path is different.

A final choice between the ballistic and ballistic should not be made until after a number of test flights have been made from orbit.

The Mercury capsule is a low complexity vehicle to do day tests of high performance man, aircraft and its design and test program are expected to meet.

Responding to later Soviet recent orbit development programs has stretched through seven or eight years.

although this last has some cost but has been reasonably long due to financial and technical reasons.

Another obstacle, in the fact that some capsule instrumentation payloads have taken two years for their design and environmental test phases. These projects did not have the necessary backing that should direct for Mercury crew.

Manned control of the capsule is expected to be completed this spring, a high-speed activity. All of the, once selected to ride in the capsule are competent test pilots and the duties they are expected to perform are minor compared to those that are involved in landing in the testing of experimental aircraft. The capsule, auxiliary systems and emergency procedures that they must maintain are derived by the number that must be maintained in a modern aircraft. Several light landing characteristics and procedures through several speed ranges are also included in the design of the capsule.

Selection of the technical complexity of the program is of the steps taken by NASA to ensure the earliest possible manned orbit, the human reaction to



FIRST U.S. space pilots examine model of Mercury capsule and Atlas that will boost it into orbit. All are test pilots with 1,500 hr. in jets and equivalent of experience in some degree. They are now in intensive training. Seated from left are USAF Capt. Virgil I. Griffin, Roy L. Mitchell, Jr., Corporal, USAF Capt. David K. Shirley, USAF Capt. Lloyd G. Cooper, Jr., Standing from left, Roy L. Call, Alan K. Shepard, Jr., Roy L. Call, William M. Schmitt, Jr., Mission L. Call, John H. Glenn, Jr.

Mercury Biomedical Program Gravity Forces			
Force	G-maximum predicted	G-tolerance	Test Equipment
Normal launch	17	10	Russian equipment
Post launch	17	10	Russian tests
Man "G" escape	—	5	Ballistic tests
Emergency	10	10	Jet-engine conditions
Normal reentry	9	10	Conings
Landing impact	10-25	10	Russian tests

● NACA Report

The overall status of the Marsary project will play a major part in determining the first flight date for two reasons:

First, since Ramo was this pet teacher, there is no way to minimize the fact that this will be the first time a new job adds a considerable amount to an attempt to achieve an ideal. There is no way to minimize the sense that this will require of the first few weeks. This knowledge is particularly important in the case of managers, designers, and customer consultants, with the prospect (unfortunately, it will lead to increased criticism and disillusionment even though all persons concerned including the sales are convinced that this understanding is no easier than an experimental) several different programs. It makes little difference now that (human) time to large markets and, however, even become almost impossible.

Second, the world is watching closely as Prigat Meyers is developed openly before it. Along with the virus of ad-venture and wonder that has been created, there is the added interest of watching a race between the two strongest nations on earth.

This private and propaganda aspect of the two-a-part program has aroused many objections, and the highest levels of government will participate in deciding when an attempt will be made to send a U.S. color info team.

The pole in the Mercury capsule will be mounted in a double-walled pressure vessel made of titanium which will be installed in a heat protection coating. The larger end of this covering will protect the atmosphere vent and absorb the greater amount of heat. Both the aluminum and heat sink, type of forward shroud will be such, the and other outer shape will be designed so that they will not change the capsule's aerodynamic stability characteristics.

The rear part of the heat protection covering will be made on a very thin, high axial alloy that will dissipate heat, heat, in addition.

Insulating material will be placed in the space between the heat shield and the pressure vessel to reduce the heat transfer to the pilot's area and to some extent scattered dissipating material. High sound levels will be experienced during the take-off boost by the Atlas and during the ascent.

The capsule life support system is designed around a maximum mission of 24 hr. A 100% factor of safety has been employed so that the system will keep the pilot alive for 48 hr in an emergency. If the pressurization and air conditioning system failed at the pressure vessel began to leak, the pilot would have full protection from his pressure suit for 720 min. Since the isolated period will only be 90 min at a maximum, it is anticipated that the Eagle could be

Space Flight Milestones

- [illegible]

started well before this period elapsed. The pilot instructs his men exactly by dropping the line on the person he needs.

The pilot is positioned in a reclining seat between and disconnected by being strapped firmly into a custom fitting couch. The accelerometer is located 10 cm from the back of the head. The pilot will be taken from back to front to front to back in a series of 10 s intervals and the signals will be stored as they occur on the boost phase as well as that the will rate forward and monitor on that position, as another when re-entry is initiated. Highest g^z forces the pilot is expected to experience will be 10 to 22 g^z for the 10 s boost phase and 10 to 22 g^z for the 10 s coast phase. Maximum g^z longer from acceleration would occur during an abort when he would receive a maximum of 10 g^z depending upon that portion of the boost phase that it was initiated in. The pilot's maximum g^z condition would be established at 25 g^z .

The radiation dose that the subject would receive during his flight will be well within the Atomic Energy Commission's tolerances. The host should and previous chamber stop inside of the radiation.

Learning System

An example system has been provided so that the capsule may be supported from its After hoist. This consists of three steel perpendicular rollers mounted on a rigid frame above the capsule. The rollers are driven from the hoist cable.

On a slight orbit from the point in the ground these rockets will take the capsule 210 ft away from the booster during the first second after they are fired. The ejection parachutes would be released as these rockets burned out and just after the capsule passed its highest altitude. The rockets are designed so that they take the capsule a considerable distance in the early part of the

A number of temperature, pressure and vibration readings will be taken on various sections of the Alfa bomber and on three engines. This data will be measured slowly during the boost phase of the flight and if it shows that trouble is developing in the booster the shut system will be actuated. The firing experience necessary to interpret this data properly will be supplied by Cosmos.

During most of its launchings, the escape system will be pressurized as soon as the capsule is separated from the booster. At that point the capsule will be pushed forward 150 g and rolled 150 g so that the pilot will be holding upright and backwards. The only way that the flight crew then be transferred quickly is to fire the parachutes located on the last track. When these are fired the capsule speed will be slowed 334 mph and a few seconds will begin. The parachutes will detach and in 60,000 ft the capsule will be slowed to 10,000 ft. During the descent to 10,000 ft. There the main parachute is deployed to lower the capsule to the ground.

The first unmanned Mariner orbit as now planned will consist of three orbits. The launching will take place from Cape Canaveral just a little bit north of east. On the third and last orbit the capsule will pass near Hawaii and the retro rockets will be fired about 400 mi. off the Pacific coast of the U. S. in order to bend it so as to launching point.

The capsule's attitude control system will consist of small hydrazine peroxide rockets to control roll, pitch and yaw. An automatic pilot will operate this system through signals it receives from an infrared horizon scanning unit that will operate capsule roll as the deck or bright side of the earth. The pilot also will have a manual control by which he can override the autopilot if it malfunctions.

The pilots will become proficient in the operation of the capsule and its manual control by spending hundreds of hours in simulators.

The five simulations in the present program are:

- A fixed analog simulator at Langley Research Center, which will reproduce the actual forces that the pilot would feel in the aircraft, and will be used to train pilots to fly the "X" series of aircraft
- Low cost simulators at Langley, which will reduce the price to the actual actions of the capsule and train him to control them
- Procedures training at Langley, which will present all possible combinations of the flight and the Apollo Launching Center at Langley, which will give the experience at traffic controlling them by activating the precise vectors
- Microcomputational simulators by placing the capsule in the large altitude wind tunnel at Ames Research Center. The capsule would be rigged to the tunnel to respond to the attitude control system. These tests would be evaluated so that the confinement would be simulated as closely as possible and the control system given an operational test. It is not certain at present whether the pilots will spend any time in the capsule itself in the Ames Research Center
- Weightlessness training at Langley

got accustomed to weightlessness by living in the Air Force C-131 which is used at Wright Air Development Center to achieve zero g for about 1 sec. at a time. The pilots will learn to perform most of the necessary capsule maneuvers during these conditions.

The aim of this automatic system is to give the pilots the ability to control the capsule during the whole flight if necessary. At the moment, plans are to let the automatic pilot control the capsule continuously with the pilot monitoring it. The automatic system would also ensure the square angle, which is very critical. There is something, however, that the pilots are going to handle this task themselves. The first one is much more complex.

The test maneuver consists, perhaps, will be made with the pilot closely monitoring the automatic system. The ability of the automatic pilot to control the whole flight will be proved first in unassisted orbits.

Navigation and Teaching

The Mercury orbit will be determined from tracking information

gathered by a number of ground stations. Atlantic Missile Range today will give the early orbit, which is very critical in missile development, and the flight must be aborted, the tracking computer program must instantaneously show the orbital trajectory, and the speed at which the capsule will land. In this way it will be possible, sometimes by waiting several seconds to initiate the abort, to bring the capsule down in the

A world-wide system of tracking and

control stations will be established to monitor the Niggers' acts. They are planned so that the experts will be in contact with each one for about 5 min and never out of contact with a station for more than 10 min.

To guard against complete measurement failure, the pilot also will have the means to determine his orbit, his position and his heading spot if he sees the short system. The accuracy of his calculations will be much lower than

those of the ground backing and computer systems. The primary navigation instrument will be a portable device. It will be equipped with a tracking head and a number of projection lines and circles. The pilot will be able, with proper training and sightings with the instrument, to determine altitude and his approximate position. Using a stop watch and making a number of these observations, he will be able to determine his speed and proper altitude and location.

A usual slide rule type of computer will then enable him to determine heaviest and his trading position at any time he chooses to abort.



FULL SCALE model of Mercury capsule is prepared for test launching at Plover, Nevada Research Station, Wallops Island, Va. Exhaustive capsule testing has been done by nearby Langley Research Center. Models built over years are accurate to 1/10th of an inch.



EQUIPLATE models are fixed to 2,110 ft. by escape pylons, powered by modified Kevlar rocket motors, to test capsule's stability with escape system. Pylon lifts crew and parachute safely, lowers capsule to water. Seats recover parachutes for later tests.



MECHANIC is shown and depicts model of earth-orbiting glider in Langley Research Center's supersonic wind tunnel. Air is forced to 400° by passage at 3,500 mph. Seal allows mechanic to inspect model without waiting for tunnel to cool.

Planetary Flight Is Major NASA Goal

A major goal of the national space program is to land men on the planets of the solar system and return them to earth. Every space project on which the National Aeronautics and Space Administration is now embarking is intended to supply some information, some experience, some capability that is needed if this primary objective is to be reached in some future decade.

Space missions, studies, the large booster projects, the space station and rocketless spacegliders—all point toward the creation of vehicles that can carry men into space for a year or more at a time.

These vehicles will push present technology to its limits precisely because they must be propelled by the most powerful engines yet devised and because they must carry "perfect" ecosystems that can operate without help or maintenance for years without decaying when manned interplanetary vehicles and their boosters will no longer be the dominant part of the space program is a main question under and possible depends on basic physical discoveries that will offer new means of propulsion.

An early evolution of manned U.S. space craft from the Mercury

capsule to the interplanetary vehicle has been outlined by NASA. Considering only the vehicle itself and disregarding such absolutely essential elements as the booster and communication and navigation equipment, the major development phases can be broken down as follows:

- Mercury type drag capsules and Deimos type lifting vehicles that will travel earthward in space in the atmosphere. These craft eventually will have several crew members but will remain aloft for limited periods because of their small size.
- Space laboratories, or satellites, the use of a few to study some basic laws, which can support several crew members for virtually unlimited periods and allow continuous and detailed observations and experiments to be carried out.

Laboratories of this general type probably will be available for testing equipment and components for interplanetary vehicles in a true space environment. While the equipment in the satellite laboratory would have to be of high quality, it would not be subject to some of the more stringent design requirements of the interplanetary journey. This is because the laboratory would be readily accessible to resupply maintenance and rescue vehicles from the earth.

- Lander vehicles will in many ways bridge the gap between the satellite laboratory and the interplanetary vehicle. The lander craft probably will push the equipment reliability requirement a link farther along and it will have to have the ability to land on and then make an unattended takeoff from a large body in space.
- Interplanetary vehicles will require some of the most advanced and complex technology ever developed and will require teams. Along with maintenance-free landers, this vehicle will need an elaborate, foolproof system to select

the land and human waste problem and a great deal of psychological support for its crew if the solar system is to be explored at the relatively low speeds at which man is possible now. Tips for the planet gliders, which are now being studied will last a total of more than two years.

A good indication of where the manned space vehicle program stands at present is the number of money going into each phase. The Mercury program is distributed in the previous article in the hardware stage and will have received about \$120 million by the end of fiscal 1960. The entire program now is expected to cost about \$500 million before it is completed. Thousands of men already are employed directly on the Mercury project.

The Deimos-type program is in its very early stages and is now being managed jointly by the Air Force and NASA in a research aircraft to follow the X-15. A few million dollars have been spent to date on Deimos-Sat studies and a few hundred men in industry and the government are now directly involved on the project. The result has not reached the detail design or construction phase and probably will not be for three or four years. Orbital flight is such a long craft without doubt since war is over.

The Deimos-Sat is a more difficult vehicle to design than the Mercury capsule primarily because it does down more gradually in the atmosphere and is exposed to high aerodynamic heating for a longer period. Its great attraction is that it will be much more controllable in the atmosphere, than the pure drag capsule. The capsule would use the guidance problem for space vehicles carrying planetary reconnaissance, as well be discussed later. It also would provide a more useful and versatile vehicle for scientific studies and for use near the earth that is which travel as back the atmosphere and its zone.

Fast Deimos-Sat vehicles will probably be confined to a very narrow flight corridor of permissible speed and altitude conditions. Aerodynamicists expect that the challenge of winning this corridor and retaining the usefulness and reliability of winged vehicles will continue for many years. While this flight corridor is being narrowed, the maximum data requirements that the world can endure so it can fly faster in the air laboratory and improving its aerodynamic lifting efficiency so it can fly higher at low speeds.

A vital part of the research that will help widen that flight corridor is related to developing methods that will permit good structural analysis at temperatures approaching 3,000° F. Some plans that are under the basic research area will provide an experimental in propulsion

systems as well as structures, so that the job of vehicle design would be simplified from two directions.

The space laboratory program is in the study phase and \$2 million is approved by NASA during fiscal 1960 for theoretical investigations of the problems that will be involved in operating natural and man-made laboratories in stations in orbit over the earth.

Booster Developments

D. D. Wright, technical assistant to NASA's Director of Space Flight Development, recently told Congress that the interplanetary program—set in all other NASA plans—will have to be levelled to boost development. The management expects it to have laboratories of increasing weight and complexity, made for use as more powerful boosters become available.

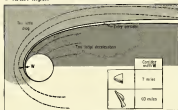
General purpose of the existing laboratories is to expose men and large equipment stations to actual space environments for very long periods. They also will be available for performing some elaborate measurements and observations of space conditions and the various that will be possible with an assumed satellite.

Wright said that Vega and possible Centaur would be the first booster capable of putting up a large enough vehicle to contain the life-support systems and all of the equipment that we would desire to maintain a man in orbit for a period of from days to weeks and perhaps on into months. He listed a specific objective in this area as putting men on more than far as needed in three months for a long term study of their behavior and psychological and physiological reactions to the space environment for the long period.

In the equipment being used, certain smaller vehicles might be tested before Centaur or Vega become available. This would be done by placing them in orbit in capsules equipped with the necessary power supply to operate the



EARLY X-15 shape in Langley free flight tunnel tests low-speed stability and control characteristics of use of differential control of horizontal and vertical deflection.



TRACKING on single pass planetary observations is limited to circles by line, distribution considerations. Only one return is preferred due to possible solution hazards.

system. Data on their functioning could be referred to the ground and the capsule recovered after several months in space so that a close inspection of the test apparatus could be made.

Still many elements have to be considered in the design of the test apparatus. "We first see need to go beyond the temporary sort of a space laboratory, and will eventually want a permanent laboratory in which we can take man up and bring them back," Wyatt says. This laboratory would be the use of a small house and have a dome or more men in its crew.

The first vehicle capable of putting up such a unit is one that would be in the first step. None is expected to be made sometime after 1985. It is possible, however, depending on the technology of this laboratory that the permanent laboratory would be put up in orbit by the Gemini or Vega and assembled in orbit.

Dissemination of the great commercial and scientific benefits of such a permanent laboratory above the atmosphere have indicated that its operation, probably would be divided into four principal areas. The first would deal with observing the earth, its atmosphere and space around the earth. The second would involve environmental and ecological observations. The third would be basic research in physics, medicine, and other sciences, which would determine among many other objectives the detailed effect of the space environment on animals and living tissue. The fourth would involve testing of equipment for future space vehicles.

The biomedical questions about man's adaptability in space should have involved in most respects by the time such a laboratory was launched,

and the crew of this station would be spending personal time mostly with performing these assigned tasks.

Present NASA thinking is that permanent laboratories would be supported frequently from the ground. They probably would have equipment to replenish the air supply rather than bring new oxygen down at regular intervals. Food supply and waste disposal might have to be handled by automatic vehicles from the earth, at least in the early stages of the laboratory's operation, as a man can't live on his own food every 30 days and maintain more than a ton of food in less than a year.

Biological System

One of the most important long-range goals of the biomedical program is to develop a closed ecological system that will provide food and water from human waste, with the only input being electrical power. Douglas E. Welch, chief of NASA's Biomedical Life Support Systems, predicts that a prototype recycling system based on the use of algae could be ready for testing in about six years. Not the least of the problems involved in regenerating waste is the rebirth of man.

While entire laboratories are still very much in the conceptual stage and far from being built, some have been built by Wyatt and other NASA officials.

"The information that we learn from experiments conducted in laboratories of this sort will be vital in the successful development of truly self-sustaining systems such as manned flight to the moon," Wyatt told Congress.

An indication of the pace presently being applied to lunar exploration is the appropriation of \$7.15 million that NASA has budgeted for this purpose in

Fiscal 1980, evidence of vehicle development. The exploration of the moon will fall into four separate phases, which will be treated in the sequential development of future boosters. These phases are:

- Orbiting the moon, insert and land landings. It should be possible to accomplish these maneuvers with only one of the Thor-Delta booster becomes available early in 1969. This vehicle will have a guidance system located in the second stage that will function throughout the burning of the first two stages. This provides a significant improvement in accuracy over the first stage probe vehicles used by the US.

J. Allen Cracker, chief of NASA's guidance and control program, has indicated that there is a feeling of urgency about getting instruments onto the moon's surface and that NASA is even using instruments which can be designed and built to withstand impacts of the velocities of the order of 7,000 to 8,000 ft/sec and continue to operate after impact.

Two types of shock absorbing vehicle to land these rugged instruments are being considered. One is a spherical container with the instruments in the center, surrounded by a shock absorbing material. The outer surface of the package would be designed to deform a great deal upon impact. Another potential design would employ a long tapering cone that would absorb impact as it penetrated the moon's surface for a considerable distance. Shock loading of the instruments would be reduced further by connecting the upper part of the spike to the instruments so it would absorb most energy as it collapsed.

An alternate approach to the landing problem is to take about half the Thor-Delta apogee period and use it for a small retrothrust, which would slow the package just before it hit the moon. This low velocity impact would allow the instruments to be lighter and less rugged. The landing still would be an added task, however, and the choice between helicopter and landing-vehicle design has not yet been made.

Unless the type of instrument package delivery can be accomplished within about 15 months, the present probably will be discarded because large landers will be able to carry enough payload to allow a soft-landing—should be available by then, Cracker said.

Orbiting the moon is considered to be an easier job than approaching with a single vehicle, because the single vehicle would have to enter the moon's gravitational field precisely along a path to avoid being diverted from its proper course.

The Thor-Delta orbiting payload would be reduced to about 65 lb, with



MERCURY epoch model first at Mach 3 by high-speed gas flow measurements made at Ames Research Center shows action lines and antennas. Apparent ledge at edge of model from a optical distortion. Scratched line is the leading model in launch gun.

15 lb being devoted to a retrothrust. NASA hopes that such vehicles will make it possible to gather improved information on the lunar man and to make a high-resolution map.

• Soft landings. The Vega vehicle, scheduled for first flight through mid-1969, and the Centaur to be ready early in 1961, will be able to make soft landings on the moon with a 490-lb and 710-lb payloads, respectively. Purpose of the soft landing is to position scientific instruments at precise locations on the moon's surface.

Soft landings have a number of requirements which call for a much more sophisticated vehicle than the Thor-Delta. These include terminal guidance, located in the last stage, attitude and altitude control of the vehicle as it approaches the moon, a retrothrust to control velocity of the forward velocity of the vehicle, ability to maneuver

above the surface of the moon so that the left-hand point can be altered, and some means of absorbing landing shock.

Both the Vega and Centaur will also be used to carry large payloads into orbit around the moon to aid in mapping and general reconnaissance. They might also be used to make hard or impact landings.

• Soft landing and return to earth. Saturn vehicle, with 1 ton of lift, is at least an first stage, will be needed to land a 200-lb payload soft, on the moon and return a part of it to earth. The payload would not be landing gear as a living platform and have the part behind on the moon to lower the weight to be returned to the earth. The payload would be recovered on the earth by a large capsule falling, using a retrothrust. Saturn might possibly put a man into orbit around the moon but this mission presently appears to map-

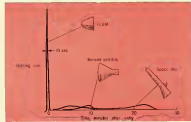
out that it may not be attempted. • Manned lunar landing. This will have to await development of other the Nova chemical rocket weighing in the neighborhood of 5 million lb, or of nuclear rockets, which would allow a vehicle of much lower total weight to be used. NASA estimates tools are that the manned landings on the moon will not occur before 1976. Even to this, however, manned vehicles launched by a Nova or a similar vehicle probably will have needed the moon and returned to earth.

Nova's payload capacity is not particularly high for the manned landing on the moon. The big rocket could only support a 2,100-lb payload to earth. One method of taking this mission out of the marginal category is to cache food and fuel on the moon at the location where the Nova vehicle would land. Storing these supplies would allow landing vehicles going to a manned trip to be considered by the NASA.

Interplanetary Vehicles

NASA has suggested \$6,000,000 for deep space probe work during fiscal 1980, not including vehicles. This money would be used to continue a program in progress during fiscal 1969. Part of the 1970 program was to develop a vehicle which could travel along the minimum energy trajectory to the Venus orbit.

Two vehicles, one a Thor-Able and the other an Atlas-Able, are being constructed for this purpose. They were to have been provided by a Thor-Able out of parked components, fired into an elliptical orbit. The most favorable firing point for Venus would have occurred on June 8 and the total energy required to come within the vicinity of that planet increases over the other that in Venus orbit, farther away from the earth. One or both of these vehicles probably could reach Venus if they are



HEATING differences in drag bodies such as cosmic dust and Mercury capsules and left vehicle height indicate that future landing vehicles will be taking shape. First drag vehicle also may be used as escape capsule for earth-orbiting spacecaps.



HYPOTHETICAL (upper left) using nuclear rocket propulsion includes landing vehicle and crew compartment, right engine, left, exhaust nozzle for liquid hydrogen propellant, shields to protect tanks from solar radiation, reactor core.

launched any time during the 50-day period after June 1. The energy requirement runs up rapidly after the first of July, and it is possible that an U.S. rocket could reach Venus until the next maximum energy period on Jan. 17, 1967. Next Venus date would be Aug. 16, 1962. Favorable dates for Mars landings are Oct. 1, 1960 and Nov. 16, 1962.

If the Thor-Able and Atlas-Able assigned for the Venus shots are not used for this mission, they probably will be employed late in the summer or early spring. One Thor-Able still may be used to boost an instrument package into a highly elliptical earth orbit with a 200-mi. perigee and 30,000-mi. apogee. The Atlas-Able may be used to orbit a payload around the moon.

A number of studies of interplanetary vehicles have been conducted by some of NASA's best scientists. The chief purpose of most has been to determine where further research effort can be most profitably applied. These interplanetary studies have investigated vehicles powered by chemical, nuclear and electric engines and thus have laid the desert impetus behind much of NASA's current and planned research program. A very large percentage of the information needed to design an interplanetary vehicle will not be obtained through any earth-based research program, however, and much of the solid design data for these craft will have to come from the orbital experiences that NASA is planning.

Rather extensive studies already have

been made of the problem of entering the atmospheres of other planets after a fly-by from earth. Dr. R. Chandra, NASA astronomer, has directed most of this work.

Chandra points out that a space vehicle on any trip between earth and Mars or Venus will approach its target planet with about twice the kinetic energy of an earth satellite or an intercontinental missile. The ideal solution would be to use rocket braking alone to make a landing, but this would require a rocket system as large as the booster rockets that propelled the vehicle in the first place. The total weight of such a vehicle would be 10 to 15 times as large as those now contemplated. In view of this the research effort is being directed toward solving the entry problem by using aerobraking, with rocket power during that phase needed to make small corrections in trajectory.

Radiation Hazard

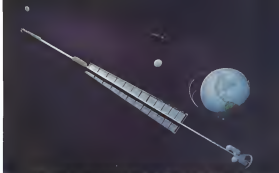
Multiple-pass atmospheric braking, which looked very promising until last year, is being discarded. This is because the space vehicle would have to pass through one radiation belt several times as it gained the edge of the atmosphere and exit its vicinity very slowly. The weight of shielding required to protect occupants during these passes would be "unfeasible," according to the information available now, Chandra said.

While it is not certain whether radiation fields of the same type and intensities as the earth's fields exist

around Mars and Venus, a single-pass landing method is being studied seriously for the interim flight to earth, and probably would also be employed for landing on the other planets.

On a single-pass landing, the vehicle must be pulled down a narrow corridor of aerobraking drag in going to cut its speed enough to land without slowing it too rapidly and producing discomforts that would kill its crew. The earth's landing corridor for a one-passing drag vehicle of the Mercury type is only seven miles wide. If a lifting vehicle can be used, the corridor will be widened to about 60 mi. But this is still less than one per cent of the diameter of the earth, and presents a very severe guidance problem. The penalty for widening the corridor is the greater weight and complexity of the manned vehicle.

The single-pass landing corridor on Venus is about the same size as that for the earth, but the Mars corridor is much broader. Landing corridors for the other planets are considerably larger in proportion, but, in any case, it is much narrower than the earth's. NASA officials already are discussing atmospheric probes to the vicinity of that planet. Of the three planets that will be reached to extend trips from earth to Mars or Venus and return, the earth landing problem is the most severe as far as vehicle decelerations and surface temperatures are concerned. A demonstration by an unmanned vehicle that such a one-pass landing is possible probably will precede any manned flights to the nearest planets.



MANNED flights to planets may await nuclear electric engines. This is a proposed Mars vehicle.

TEST vehicles for first manned orbital flights. From left, Little Joe, Atlas, Jupiter, Redstone.





CATHODE jet is obtained in electromagnetic traveling wave plasma accelerator used in space propulsion study at Lewis.



BED-VIOLET flame indicates beflow of lithium vapor from electrodes as accelerator starts. Researcher is Robert E. Jones.



EXTERNAL fuel burning studies at Lewis. Possible future tests are for liquid-gate control, propulsion system for cruise at Mach 3-10.



ION accelerator at Ames studies surface plating effect of ionized gases on spacecraft at speeds of 15,000 mph.



CNS-THREE scale models of Mercury capsule, left, at Langley, are fired to 1,000 ft to test effect of escape rocket on capsule's stability. Right, full scale booster-plate model is fired to 2,250 ft at Wallops Island in escape system test.



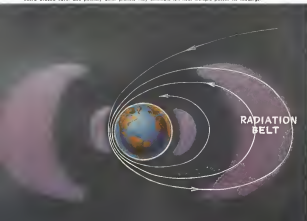
HELICAL telemetry antennas receive temperature, pressure, acceleration data from dynamic models of spacecraft fired by rocket over Atlantic from Pilotless Aircraft Research Station at Wallops Island, Va. Station is now being expanded.





DEBIE radiation belts, found by early satellites, raise still unanswered questions on magnetic field.

BEETS around earth and possibly other planets may eliminate low-cost multiple passes for readings.



UNCONQUERED include those that record gas loss and compare earth's magnetic field, those that plot, aim and gauge how way outer field. Estimates on intensity of possible magnetic field may be more than one million.

Sciences Program to Probe Universe

The bold space sciences program of the National Aeronautics and Space Administration will probe from the shores of the earth's own atmosphere through the solar system and into the far reaches of the universe.

The NASA program could have a far greater impact on present frontiers of knowledge than the great age of exploration that opened the Western Hemisphere in the 15th century.

To the space scientist, powerful winds and outer fields are not as real as themselves—only a means of carrying scientific instruments and to allow instruments to be made that will reveal what heretofore has been hidden to conjecture. In answering questions that have long intrigued scientists, NASA's program promises to raise many new questions, but this is the purpose of scientific investigation.

Experiments Planned

Here are a few examples of space science experiments currently proposed or planned.

- **Interplanetary probes**, to measure the pressure, density, temperature and composition of the atmosphere of Venus and Mars.
- **Interplanetary studies** of the regions surrounding earth and other planets and their effects on radio communications.
- **Orbits of energetic particles** such as cosmic rays and Van Allen radiation belts, and their reactions with space vehicles, the earth and other atmospheres.
- **Mapping of the solar system's magnetic field** and study of anomalies in the earth's magnetic field.
- **Space astronomy**, using a telescope mounted on an attitude-stabilized satellite, to observe radiation from celestial bodies that now is absorbed and/or filtered by the earth's atmosphere.

Although man lives in a world of physical phenomena that are governed

by "fields," such as gravity and magnetic fields, scientists have very little realization of the true nature of a field, according to Dr. Robert V. Fritsva, head of NASA's chemical sciences program. A field usually is described by the effect it produces, such as the pull of gravity or the use of a magnetic field to generate an electric current.

Arise from fundamental scientific curiosity about the nature of fields, there are important practical reasons. Pollution, pests, and for example, fields determine the motion of all free particles from the fastest electrons to dust grains.

One of the most familiar is the

earth's magnetic field, yet it poses many unanswered questions. Its strength increases and weakens (shifts) daily over a period of years, at what is known as secular variation. More recently it has been discovered that it has a 2300 (thousand) mile of very small magnetic field.

There also are brief random variations with periods of a second to a few minutes which now persist for up to half a day. The magnitude and its frequency of occurrence of these variations depends upon geomagnetic latitude. Conducted magnetism is found in the ground some 1000 miles from the earth's surface. These are not magnetic fields that produce large fields, variations over periods of all of the earth.

One theory is that some of these variations in the earth field result from electric currents flowing in and about the atmosphere. The currents are at



CANADA will supply satellite, U.S. the launch, for atmospheric "topside" studies that will provide simultaneous study of ionosphere's nature from above and below.

Energetic Particles—18-Month Program

Program
 Measure ion intensity in interplanetary space
 Detect ray fluctuations
 Measure ray energy and charge spectrum
 Reconstruct both composition and total
 Anomalous particles

Loadings
 2 proton, 1 electron
 1 satellite
 1 probe, 1 satellite
 4 satellites, 4 probes
 1 small vehicle

Ionospheres—Two-Year Program

Program
 Ionospheric structure, ray low frequency properties, low frequency scattering
 Ionospheric structure, properties, ionospheric interaction with satellites
 Ionospheric structure in early earth orbit

Loadings
 2 earth satellites
 1 space probe

trahed in the dynamic action of solar wind and in the scattered ion and to the influx of particles from the sun.

Another recent theory, put yet unproved, suggests that clouds of ionized gas from the sun generate a magnetic field which interacts with and compresses the earth's magnetic field.

Under other conditions, where the type of particle and energy level is different, the particles may become trapped in the earth's field, causing a weakening of the field. As particles oscillate back and forth along the earth's lines of magnetic force, they may produce short-term pulsations in magnetic field strength as measured at the earth's surface.

It is known that the sun has a magnetic field in both ways in intensity with the appearance of sun spots and bursts of solar energy. Some scientists speculate that Venus, Mercury and possibly other planets have such magnetic fields, but there is no data to support this

belief. Scientists also suspect that there may be an intergalactic field, but again there is no confirmation.

Present NASA plans call for a lunar probe using a radiation-type magnetometer designed by Vavri (Astronauts to measure electric currents and earth's field at great distances, as well as the interplanetary and lunar magnetic fields. A number of small sounding rockets will be outfitted with probes magnetometers to study ionospheric structure. Two satellite experiments are planned to obtain data that may show the relationship between magnetic storm bursts and changes in the field on the earth's surface.

Because the short-range program, NASA hopes to measure magnetic fields of Mars and Venus, mutually through close approach and eventually from unmanned satellite landings.

Einstein's general theory of relativity suggests that gravitational fields slow down physical processes, follows points

out. This means that if one of two identical clocks is located in the gravitational field of the earth, and the other is placed in a satellite where it is exposed to a much weaker earth gravity field, the satellite-based clock should run slightly faster, a few parts per million.

NASA plans an experiment using extremely precise atomic clocks to test the validity of this aspect of the relativistic theory, which forms a cornerstone of modern physics and astronomy. Clocks from the satellite should be sent from the earth-based clock to test the validity of this aspect of the relativistic theory, which forms a cornerstone of modern physics and astronomy. Clocks from the satellite should be sent from the earth-based clock to test the validity of this aspect of the relativistic theory, which forms a cornerstone of modern physics and astronomy.

Follows more, however, that the experiment will require a great deal of precision and control because of the extremely small effect to be observed. If the satellite orbits too close to the earth, the result may be an opposite effect that would cancel out the slight time shift that must be observed. An orbital altitude of 4,000 to 5,000 mi should prove adequate, follows below.

Origin of the Universe

By examining reflection of matter from space before it is observed, Howard and his associates at earth and its atmosphere, NASA scientists hope to shed light on the question of how the universe began—whether it is continuous matter expanding from a first explosion of matter or whether matter is in a continuous process of creation—recreation at the Big Bang.

Although evidence has been found on earth, scientists are not certain they see the same in the motion that light the universe day. Microscopic fossil on earth are solid and hard whereas air-born fossil, up to that time as soft as some fishes, O'Keefe says.

If a few meters can be captured in

space and returned to earth for study, it should be possible to determine a great deal more about the physical conditions at the origin.

O'Keefe indicates that violent explosions on the earth may have been common since the earth, but there is no way of observing them, as such at present. If a lunar probe vehicle could bring back only a small sample of the earth's surface, it would enable scientists to identify lunar materials from other extraterrestrial samples.

Overcoming the difficulty of obtaining a small sample, O'Keefe said that it would provide the existing balance "something we know is a constant and something we are through the telescope."

The earth's atmosphere has long denied scientists much more than it has tried to get at planets and the stars because it diffuses visible light and permits only a small portion of the electromagnetic radiation spectra. By placing a telescope and/or other electromagnetic radiation sensitive devices in a satellite above earth's atmosphere, scientists can greatly expand their present knowledge.

With access to gamma rays and X-rays, for example, it should be possible to learn more about the sun's corona and the region of outer rays between the region of visible light and the main gases, scientists will gain access to molecular radiation, which may reveal the composition of the moon's surface or whether it is similar to Mars.

Access to the satellite long radio wavelengths now blocked by the ionosphere may reveal details on the motion of very large planets, stars and of galaxies in a cluster. Perhaps in the region we would be able to find the greatest parts of the universe," O'Keefe speculates.

The earth's atmosphere, the spherical shell of charged (ionized) atmosphere gases extending from an altitude of about 50 mi to tens of thousands of miles, provides the vital mechanism in which high frequency radio waves are reflected around the earth. Keyhole 24-hr cycle changes in the ionosphere disrupts other radio propagation, and genetic changes are completely disrupted radio communications.

Before the advent of satellites and sounding balloons, scientists had peered together a limited picture of the ionosphere from earth-based radio soundings. It was believed that ultraviolet rays from the sun produced ionospheric ionization during daylight hours at low altitudes. At night the ionosphere rose to 50 to 60 mi, the E region at 60 to 75 mi and the F region at 120 mi and the F region at about 150 mi. At night the ionosphere became much more uniform, while the D region disappeared entirely.

In the Arctic and Antarctic, ionospheric activity was known to produce aurora and changes in the ionosphere, with various degrees of radio communications. But the real cause and effect mechanism was not defined only by ionospheric changes.

During the International Geophysical Year, rocket probes in the Arctic revealed that the disturbed low-altitude D-layer ionosphere was due to X-rays from the sun, not ultraviolet radiation as earlier supposed, according to Dr. John F. Gault, chief of NASA's planetary sciences program. This principle has the hope that it may be possible to interpret disturbances in Arctic communications well in advance of their occurrence as important cues for real-time applications.

Scientists also learned that the entire ionosphere is a complex region with only minor variations in the density of charged particles, and not a series of layers with deep troughs separating them, as had been thought.

Small satellite and rocket data confirmed that the density of charged particles above the F-region maximum decreases far more slowly than had been thought. The density of charged particles 100,000 per cubic centimeter from 300 to 1,000 mi.

This indicates that the bulk of the ionosphere lies above the F-region at 100 to 400 miles but below it is probably thought. Therefore the ionosphere may have a greater effect on communications between space vehicles and on its than had been anticipated.

Research Objectives

NASA's ionosphere research program objectives include the following:
 • Determine structure and composition of the ionosphere and its relationship to the atmosphere.
 • Determine whether ultraviolet, X-ray or other radiation is the mechanism responsible for much portions of the ionosphere.
 • Determine if the ionosphere is a continuous or a discrete medium.
 • Determine if the ionosphere is a continuous or a discrete medium.
 • Determine if the ionosphere is a continuous or a discrete medium.
 • Determine if the ionosphere is a continuous or a discrete medium.



LATER vehicles will explore planets, send payload back to earth, or return to earth.

• Low-altitude region structure above 200 mi altitude will be investigated by means of satellite and space probe soundings as well as by radio propagation through the medium. The goal will be to map structure in density and composition as function of time, season, latitude and ionospheric activity.

NASA also is interested in investigating other soundings in the solar system including those that may exist around the moon and other planets. This will be important in establishing optimum radio frequencies for communication with space probe vehicles, to permit check-out of communications when the space vehicle enters planet's ionosphere.

There are important reasons for more

Atmospheres—Two-Year Program

Program
 Pressure, density, temperature and composition of atmospheres
 Study of Venus and Mars
 Density and composition of interplanetary space and the moon's atmosphere
 Pressure, density, temperature and composition of the earth's atmosphere above 100 mi from the earth's surface
 Pressure, density, temperature, composition and winds in the upper atmosphere between 100 and 1000 mi above the earth's surface
 Wind-shear and density, temperature and winds up to 50 mi above the earth's surface

Loadings
 1 space probe
 1 space probe
 1 satellite
 41 sounding rockets
 41 sounding rockets



LEGAR surface, atmosphere, magnetic field could be measured from with back-scattering photometer probe, left; or sounding rocket vehicle at right. Side-looking vehicle, center, using instrument to learn about to payload, would follow.

Mercury Network Tops Tracking Needs

National Aeronautics and Space Administration's current and projected space program will require tracking, data acquisition and processing facilities designed to handle three basic types of missions—near-orbit, unmanned satellites and deep space probes.

The most critical and urgent need is the creation of a satellite tracking, data acquisition and communications system for NASA's Mercury near-orbit space program. NASA's choice of a computer to integrate and expand existing facilities into the required Mercury network is expected to be announced soon.

Mercury poses more difficult new tracking and communications problems because of the need to provide near-constant monitoring of pilot safety during the critical launch and recovery phases.

Extremely precise guidance and tracking is required during launch, with precise computerized control, so that an emergency abort can take place if necessary as a portion of the Atlantic when rescue will be available.

Existing Merrick stations, which occupy a number of suitable points in Africa and Antarctica, are not adequate for the Mercury needs, which is expected to recover after no more than three orbits and perhaps after only one in initial flight.

An isolated station also has been selected for the Mercury capsule for several reasons. Such an orbit will keep the satellite over friendly countries.

Equally important, both orbit will keep the capsule over the southern portion of the U.S., where many tracking radar already exist. This means that the capsule will lead to a comprehensive well-understood area of the Atlantic Missile Range.

If the more conventional southeast orbit were used, the capsule might land in the dense jungles of Central America, making speedy recovery difficult.

Affiliate Missile Range down-range tracking facilities will be capable of long orbit and recovery phase, but not during initial launch. They will require installation of a precision tracking radar, data acquisition and communications facilities in Brazil. This means that 51.8 million facility will also serve as a permanent down-range station for satellites subsequently launched from NASA's Rediffusion Aircraft Research Station at Wallops Island, Va., according to Edward C. Butler, who heads the space light operations group.

Tracking radar also will be required in Henna and Tera for recovery, but the question of whether existing radar can be used still is under study.

Existing Facilities

NASA will be creating military tracking, data acquisition and communications facilities wherever they can be found without interfering with high priority military programs in currently existing Merrick stations. Facilities had a joint Defense Department-NASA committee has made an inventory of all existing facilities as well as all military and NASA programs requiring facilities, to determine where gaps exist and to present solutions.

New military and communications facilities required for Mercury will be installed in available sites wherever possible to permit them to be added later in other sites for future NASA programs, according to Project B Staff chief of tracking programs. Shipboard facilities are planned to provide coverage in portions of the Pacific and Indian oceans.

Most of the new facilities will be used to provide continuous radar contact with the Mercury capsule and its passenger. Data on the status of both the vehicle and its passenger will be teletransmitted down, where it will be monitored by both an engineer and a physician, and start for a call station that would require an emergency recovery.

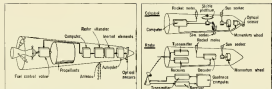
Real summary reports on the status of the capsule and passenger will be radioed back to NASA headquarters at Washington D.C., and to central control of the Atlantic Missile Range.

Tracking data will be continuously transmitted back to NASA's computer station at Wallops Island, which will calculate orbit and guidance of the recovery area when recovery is initiated.

During FY 1969-60, NASA plans to add three additional Merrick stations to the 12 already set up for International Geophysical Year satellite programs. Because no high-precision radar was planned for IGY, present stations are located between 30 degrees north and south latitudes. The new stations—on Newfoundland, Alaska, north-central U.S., and Western Europe—will extend high latitude coverage.

Existing Merrick stations will be converted to provide real-time digital data and equipment and additional stations must be added to cover the high latitude activity. In addition, old stations will be shifted to a new operating frequency, probably around 115 mc, where the present frequency 165 mc frequency assigned for IGY is withdrawn.

To provide continuous (24-hour) tracking coverage for deep space probes, NASA plans to spend approximately \$15 million during the coming year to



NUMBER of approaches to internal guidance, left, and midcourse navigation systems for use in interplanetary flight are being studied by NASA. Guidance, right, may be established in radio command, or extension of current launch guidance.

set up two stations, each one-third of a globe away on South Africa and in Australia. Each new station, similar to one now in operation at Goldstone, Calif., will be outfitted with an SSI (solid-state) parabolic antenna and accurate receiver for tracking signals transmitted by space vehicle vehicles. NASA's Jet Propulsion Laboratory will be responsible for implementing the two new facilities.

Defense Department space plans to install similar facilities in Japan and in Spain for its own military space tracking needs.

Providing reliable communications between earth and planetary probes will be a problem of great importance, according to Leonard Jaffe, who heads NASA's communications satellite program. Because at this point signal strength falls off in the square of the distance—a major consideration with the tremendous distances involved in interplanetary missions.

It would be desirable to transmit data a continuous information package. Most times a packet vehicle but that would require millions or billions of watts of electric transmitter power—costs an astronomical amount in terms of dry load and the problems that can be caused in the foreseeable future.

By transmitting back only a small pulse at periodic intervals, saving the power on a type receiver in the vehicle for slow-down transmission, and using a large antenna antenna that the vehicle can point at the earth, the required power can be reduced to the order of 100 watts. This will be a very much less imposing figure, but a space vehicle to provide, but it is within the realm of possibilities when under propulsion comes into use.

It is evident that early interplanetary probes are going to be severely restricted in the amount of information that can be added back to earth. NASA presently is studying the basic problem of how much and what type of information will be required as a

late mission. Much of this effort is under way at NASA's Jet Propulsion Laboratory.

Another important problem area is that of developing systems capable of autonomous design, vehicle, and space vehicle use. Autonomy must be able to be created after launching with high degree of reliability.

Another problem is the space probe vehicle communications problem is so serious that a technological breakthrough may be needed to provide a reliable solution. He adds that NASA is interested in having any good new ideas that seem both an engineer might suggest.

Space Probe Guidance

Recent of large probe probes, like the Vega and Pioneer, will offer the first opportunity to use sophisticated midcourse and/or terminal guidance equipment aboard the vehicle itself.

The capability provided by such on-board and terminal guidance, compared to the relatively large guidance now employed, is equivalent to the flexibility of a guided missile compared to an unguided shell.

NASA currently is studying different possible approaches to this problem with the objective of creating a program to develop midcourse and terminal guidance techniques and systems. It is not necessary to provide a probe from orbit, but that is budget will not permit a "design approach." For this reason it is working closely with Wright Air Development Center's Flight Control and Weapons Guidance Laboratory to prevent duplication of techniques which WADC is sponsoring.

Two basic approaches to autonomous guidance which have been proposed are a "continuous midcourse guidance" and a "terminal guidance." Both would be used to lead into the destination planet and other planets to provide an accurate reference for measuring the vehicle's movement through the solar system. A computer on the vehicle itself compares actual

flight path with the desired trajectory and develops corrective signals which would be applied to reaction wheels to alter the vehicle's heading. A gas discharge thruster, which the vehicle would provide short-term speed stability in all three directions of the space vehicle would not cause optical changes in line sight of these targets.

Another approach is the extension of present launch guidance techniques, with vehicle trajectory being computed by earth-based stations and corrected commands being relayed to the vehicle.

For terminal guidance, the use of radar is optical navigation, to determine location of the planet's horizon and approximate distance, to landfall the destination target. Techniques have been proposed. Another possibility is the use of a radio-wave altimeter for measuring rate-of-descent and altitude.

Although a number of existing techniques appear applicable, the real problem is to deliver them in a reliable, reliable system which is small enough and light enough to fit inside the allowable payload limits. Even for a rough launch landing, which is a rather sophisticated mission, the Vega will be limited to a total payload of about 600 lb., according to present estimates. Only a fraction of this total will be available for midcourse and terminal guidance.

What is needed is a system integration effort in collaboration with design engineers to come up with a return where compromise is not made, but where during initial launch, midcourse and terminal guidance probes, according to one NASA official.

In the coming months, NASA hopes to launch a series of preliminary studies and developments in the space probe guidance area, recognizing that the first step was required to develop such techniques and compare it with longer studies that required for the system that will carry the payloads.

Approximate Injection Guidance Accuracy Requirements

Type of Mission	Allowable Error at Injection		Remarks
	Angle (deg.)	Speed (mph.)	
Minimum guidance accuracy • Single orbital orbit • Minimum accuracy	3 to 5	100 to 200	Requirements can be met with equipment available.
Improved accuracy needed • Specific injection orbit • Nearly circular orbit	15 to 20	10 to 20	Equipment in advanced development stages will satisfy requirements.
Precision guidance • 24-hr. orbital orbit • Minimum orbital	0.1 to 0.25	1 to 2	Precision guidance in upper stages required. Also, supplementary radio links or terminal guidance.



T. KEITH GLENNAN
Administrator



HUGH L. DRYDEN
Deputy Administrator



RICHARD E. Hohnes
Associate Administrator

Space Leadership Challenge

The challenge and the opportunity lie in the National Aeronautics and Space Administration at its birth last Oct. 1 was that of leading the United States—and hopefully, the world—in exploration of the universe.

For challenges could have been more formidable, particularly when the academy reported that the U.S. astronaut corps and support personnel were the best in the world—no other nation had the advantage of a first hand start.

Second, space, scientific progress would have had more into space exploration was certainly, but without the pass of time modestly supported by the political and military establishment rather than in Soviet Russia's impetuous program in the field.

NASA Administrator T. Keith Glennan, whose name today since last October have included mentioning Congress that strong financial support of a space program is necessary, told one conference:

"Most men don't have enough about his commitment and his natural curiosity is going to carry this program forward. I think, without any question. Whether it will be carried forward at that pace that it has been carried forward is quite another question."

"Here we find ourselves in competition with another nation that is really forcing our hand in a considerable extent, that is, at least as to the manner in which we go about it, the pace at which we go about it."

Deputy Administrator Hugh L. Dryden, who headed the successful research organization that became the nucleus of the space agency, told the United States Congress:

"We have anticipated some possible commercial applications (of space exploration). We think, as a nation of both space, that we are going to have

men going out into space, and the amount we tried to make the problem the amount we are going to be in position to consider such activities."

"Now, the difference is that there is another lot of men on the way. This is especially true in a space that only big nations can play. In fact, only two or three in the world today are in a position to support this kind of a program and I feel, in many other ways, that if we are not willing to do it, there is a chance that it is going to do it, whether we do it or not."

Frankness Foretold

In the kind of frankness about the potential promise of space exploration, the need for doing it as rapidly as possible, and the great cost of undertaking it, has been throughout NASA's last history. It has been accepted—and pressed—by circumstances of Congress.

Whether the support will continue will depend on how well the space program is managed and how much it produces that is tangible enough for the Congress and the public to understand, how high the cost of the program actually goes, and what degree of promise is created by Soviet competition.

Glennan has estimated that the cost may reach \$1 billion within a few years and \$2 billion within six or eight years. Others here said that estimate may prove to be conservative. Regardless of the exact cost or cost, it is clear that it now is only in its infancy.

NASA has counted for only nine



JOHN W. CROWLEY, JR.
Associate Space Research Director

Faces NASA

months. It has been working, in Dryden said, with a high sense of urgency on a fast food line—carrying out the ongoing scientific and space probe projects to fulfill the new agency, planning and executing new projects, establishing long-range plans and objectives and building an organization adequate to carry out the overall program.

NASA began with a foundation of three major astronomical, missile and space research laboratories and the 6,000 scientists, engineers and support personnel who ran them—the former National Advisory Committee for Aeronautics.

Along with that it inherited projects, dollars and trained personnel from other segments of government. Still more important, it began with a high degree of government approval and support that previously had been denied to space projects as late as the period immediately preceding Russia's Sputnik 1.

The agency's first task, in addition to building its organization and planning a program, has been to make that long lead-time chain more began immediately. In doing that it has taken orders for supervision much of the old Air Force advanced propulsion program, added to it elements from Advanced Research Projects Agency and Army Research Office programs, and laid out a national rocket program that will provide a framework for the foreseeable transportation needs in space over the next 15 years.

One and the other major steps in formulating a national space program probably have been the most painful the agency ever will have to take. It is quite a top governmental looking, the agency has had to take away from others



PS1044 had built at Lewis after 5 years. It was developed at 1,000° at 20 ft/sec or at high Mach today. It is located in chamber for measuring altitude conditions.

in order to build its mission, sometimes at the risk of creating rivalry. The close cooperation and relationship between Glennan and Dr. James H. Doolittle, Jr., who was the President's senior aide and technical advisor until recently, and support for the old NACA's ability helped by some degree, but by no means did they make the way easy.

NASA absorbed the Navy's Vanguard satellite program and most of the Vanguard personnel, took over direction of some AEC and Air Force work, acquired the Jet Propulsion Laboratory which California Institute of Technology had been operating for the Army, and attempted to acquire the Army Ballistic Missile Agency's missile team. It had the Little Broom, at least temporarily.

From this beginning, the NASA program has grown into a truly national program. Through the National Academies and Space Council, NASA coordinates with representatives from the top echelons of government, science and industry including the President, Vice and Defense Secretaries, Atomic Energy Commission, National Science Foundation and National Academy of Sciences. It also coordinates with Defense Department through the Chiefs of Military Liaison Committee and with the scientific community through the science foundation, the National Academy of Sciences-National Research Council's Space Sciences Board, and a number of panels.

In relationship with the military services, science and industry are the



AUGUST F. SHUPERT
Bureau Administration Director



MAGNETRON equipment at Lewis Research Center ready samples of materials to within 1/1000 in. of absolute zero. Studies are stimulated by use of cryogenic fluids in magnetron equipment.



ROBERT S. GARUTH
Space Task Group Leader

also strengthened through advisory committees on specific fields of research and development, made in the pattern of the old NACA committees and subcommittees.

In spite of the strengthening of its nucleus, NASA is attempting to remain as small and as flexible an agency as possible. It has contracted the approach of the old NACA, which was to have a small fraction of its total personnel in a Washington, D.C., headquarters and keep strong technical teams in its field laboratories. NASA expects to have only 100 employees in headquarters by this time next year.

It now has four major laboratories—Langley Research Center at Langley, Va.; Lewis Research Center at Cleveland, O.; Ames Research Center at Moffett Field, Calif.; and JPL, near Pasadena, Calif.—and two lesser field stations, the Pierson Aircraft Research Station at Wallops Island, Va. which is being expanded to handle larger rocket launches, and the High Speed Flight Station at Edwards, Calif.

Construction will begin soon on the Goddard Space Flight Center at Greenbelt, Md., near Washington, D.C. It will serve as a basic research center, a development center for satellites, space probes and rockets, testing and development and data reduction systems, and eventually as a command control center for space flight operations. For its flight operations, NASA already is making frequent use of the Air Force Missile Test Center at Florida and will do the same at the Pacific Missile Range, Pt. Arguello, Calif.

Project Titan, an advanced weather

satellite, illustrates the phase NASA is in now—that of having selected a going project involving government, industry and university, and having to follow it through and plan for future experiments.

Titan will carry television cameras and a variety of radiation detectors to observe clouds, detect storms and measure depth of the freezing of the atmosphere. One satellite will be launched by the end of this year and a second next spring. Beyond Titan will come an air-borne-controlled prototype of an operational weather satellite designed for a 700-cc polar orbit.

Three staffs are an ARPA-entirety project. It includes ARPA, Army Signal Research and Development Laboratories, the Weather Bureau, Air Research and Development Command's Goddard Research Center, Ballistic Missile Defense and Missile Test Center, Navy's Photographic Interpretation Center, the University of Wisconsin, Douglas Aircraft Corp., Space Technology Laboratories, Inc., and Radio Corp. of America, which is providing some components and handling assembly and testing of the satellite.

To direct these projects and plan new ones, Garuth and Dryden have as the headquarters organization an Associate Administrator, Richard E. Horner, former Assistant Secretary of the Air Force for Research and Development, an Office of Program Evaluation and Planning, headed by Hiram J. Stewart, an associate from RPA, an Office of Aeronautical and Space Research, headed by John W. Crowley, Jr., an Office of Space Flight Development,



SOLID rocket motor of 1,000 lb. thrust and 10 sec. duration is fired in high altitude, static condition in altitude wind tunnel at Lewis to study ignition problems.

headed by Abe Schemm, an Office of Research Administration, headed by Albert T. Stewart, plus supporting activities.

The research office has four main subcommittees—astronautics and flight mechanics, powerplants, structures and materials and aircraft operating problems, and an office of research grants and contracts, for seeking basic research contributions from individuals and educational and research institutions. The latter's \$5 million budget is expected to double or triple in the next few years.

Space flight development is divided into advanced technology, propulsion, space sciences, space flight operations and program coordination.

While NASA intends to continue what Dr. Dryden calls "sufficient intensity effort to enable industrial man to keep the contact with it," it devoted at a series of papers that development and operation of space vehicles and many of their problems would be carried out largely by contract with industry, educational and governmental groups and that industry, universities, NASA and other government laboratories would supplement this by payments of basic and applied research in the ground work for future development.

National Program

Since its inception last Dec. 1, NASA's national program already has gone with swiftness. Of the planned lunar probes that NASA selected, only one fulfilled its mission, although other probes yielded valuable information on the Van Allen radiation belts. Initial plans to launch a rocket with a 50,000-lb. stage and 700-ton payload and two probes in the direction of Venus have slipped badly and the Venus shots would eventually be postponed for a year or more. The Venus program has been a disappointing start.

But a great deal of new scientific knowledge already has been gained about the earth's shape, its atmosphere, the radiation belts, the Van Allen effect and the program occasionally shows more relatively hastily conceived experiments rather than part of a comprehensive, long-range program of the type NASA is supposed to develop.

Following the launching of Sputnik, 1, initial criticism of the U.S. was that it had failed to recognize the value of and support space exploration as a high priority, national effort.

This now is being done, and the pace of what is becoming an aggressive, integrated national program will depend largely on the firmness and the performance of the various government agencies from that has had the challenge laid before it.



SHADOWGRAPH of X-15 in simulation model of X-15 rocket aircraft itself fired from gun gun at speed of Mach 2.5 in supersonic flow flight wind tunnel at Ames Research Center. Grid permits accurate measurement of position and flight angle. Below, top view of model flying at Mach 5. Ames has conducted extensive tunnel program.



TOP VIEW of X-15 in static tunnel at Mach 2.5 shows flow pattern and pressure fields. X-15 built by North American Aviation, Inc., under a post-NASA USARF program, already has made flights attached to Boeing B-52 mother ship and has begun free-flight probe program from Edwards AFB, Calif.



Industry Has Key Role in Space Work

The nature of a space program designed to explore vast new frontiers demands that the money to finance it will follow a sharply rising curve.

The importance of this to industry already is evident in the first two budgets of the new month-old National Aeronautics and Space Administration. Of the \$270 million total requested for fiscal 1959 and 1960, \$600 million will be spent for research. Some of this will be spent by research but the bulk of it is for development and procurement of space hardware.

The best indication that the spending curve will be based upon rapid growth in the space program goes out of its industry content from NASA's administrator, T. Keith Glennan. Glennan told Congress he believed that this year would be the last time his agency would not be "on little or half a billion dollars."

"To try to go beyond that is really cost ballooning," Glennan said. "But I would not be surprised to find within six, ten years, that we might be asking for \$1 billion in this program. Our viewpoint on that is that there will be a general level, as you will find in other space science investigations which will be added year after year at a level of about one."

"What this will be I can't tell you now, but when you come, on top of that last, specific programs such as the lunar program I have suggested, it might reach as much as \$1 billion in the next six or eight years. When one reaches further such changes as the moon surface program—that probably will involve \$200 million—will come on top of that so it ought to be an increasing program."

NASA's New Role

NASA was created around the nucleus of the old National Aeronautics Administration. At the end of the 1960 fiscal year, it will have the equivalent of almost nine years of NASA budgets. Although the space agency still is primarily a research and development agency—developing new knowledge and techniques in its laboratory—it also has a major role in conducting and operating space

Science is part of its first year's budget and 77% of NASA's budget for the next year will be paid out to educational, research and industrial groups. While on NASA's fiscal will grow, this percentage will change in the future, it seems likely that it will continue to increase. The growth occurs in laboratory facilities or personnel in research, but procurement of space hardware and perhaps is sure to increase rapidly as development projects reach the actual stage.

To handle this, industry requires assignment of selecting contractors and developing and administering contracts. NASA has followed the more approach it used in putting together a military space program—it has made judicious use of existing organizations and procedures, long at the same time to maintain a flexibility and independence of its own.

NASA is following the general pattern of research and development procurement that has been set by the other services, although there are some important differences.

One of the most important is larger industrial than that the agency is not adopting the system of contract procurement which is common in other services where one of the most important considerations.

Under the military approach, the contract is awarded to a prime contractor, who in turn selects and lets contracts to subcontractors and is held responsible for the complete working of the entire program. A report developed in this concept from the point of view of smaller firms, it is that the prime is inclined to keep in his own plant a great deal of work that might otherwise be done by a subcontractor.

Although none of the new projects begins in NASA, since the nation concept the military, since space program costs have become the agency and government is high enough that it might almost be considered a civil agency.

According to Ernest W. Blackett, who leads NASA's Procurement and Supply Division. For this reason, considerable money is being placed on the private contractor, McDonnell Aircraft Corp., for the capsule and some ground support and training equipment. Yet the military project is not a true example of the private contract system. NASA is buying the hardware from General through Air Research and Development Command's Ballistic Missile Division and the vehicle through Army's Ballistic Missile Agency, and still often direct from industry.

Typical Procurement

A more typical procurement approach is that being used in the Vega landing vehicle, which will be capable of putting 3,000 lb into orbit above the moon. Since this vehicle is based on the Atlas missile, NASA has awarded Constellation a \$13.5 million award contract, which for test flight tests in 1960 and delivery of eight vehicles in 1961.

In stead of having Constellation with General Electric, the engine stage engine, it is being under the new approach. NASA contracted directly with GE. NASA's Air Force main laboratory is developing a third stage liquid fuel engine, which is an engine will be manufactured by some independent company. It also has technical direction over the Vega project and other contractors will figure out development and fabrication of whatever parts are used with Vega. NASA is taking an almost completely decentralized approach to its contract work. Although research grants and research development contracts will be handled at headquarters, any contract that support specific projects will be made at the laboratory where the project originates and is being carried out. Moreover, in example, is being carried out by Robert Gillett's Space Task Group from Langley Research Center in Virginia, and contracts for the capsule hardware and ground support work and other phases of the program are being written there.

The purpose of this is to keep evaluation of proposals and technical evaluation of contractors in the hands of those responsible for the project to a great degree in possible.

All but the smallest contracts are reviewed by the small headquarters staff of 31. In addition, the Air Force and the Army procurement specialist for 17 years have been NASA, but latterly, believe that staff must be kept as small as possible and describe them as a "house" of procurement specialists, if the flexibility needed for

rapid operations is to be maintained. The speed with which the agency's role of procurement was taken in 1958 is illustrated in amount of the funds already committed. In the, on average between the agency's beginning last Oct. 1 and the end of April, \$140 million of the \$150 million in fiscal 1959 contract funds had been committed, and so had \$105 million from the fiscal 1960 budget. One reason for this rapid speed was the fact that NASA took over some development projects that other agencies already had in progress, but even in these it generally had to write new contracting agreements.

Contracts for the 13 vehicles to boost Redstone single chamber rockets and the McDonnell capsule, which Blackett lists "two of our largest and most intricate procurements" were placed within three months after the procurement work began. Other procurement contracts were completed within 15 days, including acquisition contract drafting, execution, award, approval and distribution.

The reason of speed and certainty and because it is doing business with contractors already in the defense industry, NASA is operating under the general principles and practices of the Armed Services Procurement Regulations. It also is included under the Federal Acquisition Regulations, which apply to government agencies other than Defense Department and are quite similar to AFPR, and NASA has reported to be allowed to follow the AFPR wherever there is a conflict between the two sets of regulations.

Formal advertising for bids will be used whenever possible by NASA on contracts but the nature of research and development work makes it impractical to make most contracts because of defense specifications can be written. Most negotiated contracts will be non-competitive, and contractors are asked to submit the most types of work, down and cost information usually requested by the military departments.

NASA has a contract audit at headquarters but it will not have the same level of review as the military. It has asked the contractor to submit its contract to specific manufacturers' plants. Examples of this are Air Administration of the McDonnell capsule contract and Air Force administration of the Redstone engine contract. Technical agencies, even with NASA, possess

An important difference in NASA's contracting procedure is that in some cases, the government must take the title to equipment, unlike the practice under the AFPR. NASA's patent regulations have been published in the Federal Register (Oct. 1, 1959), and questions on these should be directed to

NASA Research & Development Programs

	FY1959 (estimated)
Aircraft, missiles, and spacecraft research	
Support of NASA plan	\$14,075,000
Support of AF plan	5,100,000
Research contracts	2,500,000
Scientific investigations in space	
Research contracts	3,000,000
Scientific satellites	2,000,000
Launch probes	2,100,000
Deep space probes	4,000,000
Scientific applications investigations	
Manufacturing	18,000,000
Communications	4,700,000
Space operations (rocket test)	
Maxwell space flight	7,500,000
Space rendezvous techniques	5,000,000
Space propulsion technology	
High speed propulsion systems	2,000,000
High speed solid state propulsion systems	20,000,000
Major test engines	5,000,000
Space engines	2,000,000
Aeronomy probe units	2,000,000
Space systems technology	
Advanced vehicle systems	1,500,000
Basic or research systems	1,000,000
Orbiting space laboratories	2,000,000
Human factors, training and data acquisition	11,000,000
Vehicle development	
Small	2,000,000
Large	10,000,000
Vehicle	42,000,000
Other	41,000,000
Total	\$99,375,000

the Assistant General Counsel for Robert M. Allen at NASA headquarters in Washington, D. C.

NASA recently appointed Joseph M. Rice, formerly chief of research at Army's Westhampton Research Station, as director of the agency's technical and scientific programs.

Heads of the agency's five main working NASA centers should obtain and file our copies of the following: Mailbox List Application (Government Standard Form 159) and file with our headquarters and our contractors. These forms are available at all NASA locations. These plus any brochures may be mailed to the agency and we will forward a booklet entitled "Selling to NASA."

Although NASA welcomes scientific and technical proposals, it does not take such a proposal "may possibly be accepted after technical review and then it will be reviewed. If it is accepted, a contract will be negotiated but funds are limited, and only projects that appear to have a direct and immediate bearing on the NASA program will be accepted. If it is not accepted, a contract will be negotiated and space agency groups.

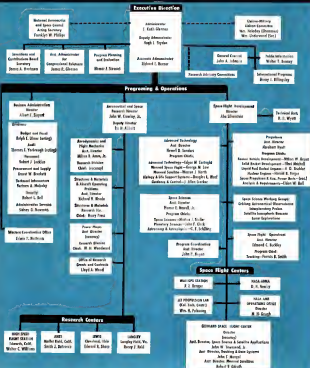
has altered the mission of NASA's research center, the following is a list of the center, their general area of work and their contracting offices:

- Langley Research Center, Langley Field, Va. Aerodynamics, Propulsion and other research and development.
- Lewis Research Center, 11000 Brookpark Rd., Cleveland 13, Ohio. Fuels and engines. Propulsion effort for aerospace and aircraft.
- Goddard Space Flight Center, Greenbelt, Md. Rocket and spacecraft development and testing.
- Ames Research Center, Moffett Field, Calif. High speed flight. Propulsion.
- Langley Research Center, 11000 Brookpark Rd., Cleveland 13, Ohio. Fuels and engines. Propulsion effort for aerospace and aircraft.
- Goddard Space Flight Center, Greenbelt, Md. Rocket and spacecraft development and testing.

How NASA Dollars Are Spent

Research and development	FY1959 \$103,700,000
Science and engineering	54,000,000
Construction and equipment	27,000,000
Total	\$184,700,000

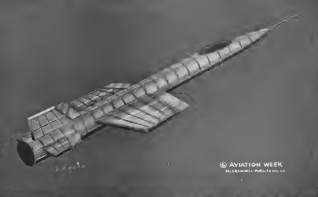
National Aeronautics and Space Administration



X-15 Progresses From Model Stage to Glide Flight

North American X-15 landing, above, and in flight (right) appears somewhat similar to the X-15's recently made first free flight (AW June 15, p. 20). Model is one used in National Aeronautics and Space Administration's Langley Research Center to study stability and control characteristics of use of deliberately controlled downwash test for full control at low speeds. Note shadow of Lockheed F-104 close plane in landing photo.





AVIATION WEEK
AN IRVING-CLOUD PUBLICATION

WYPERSONIC aircraft suggested by finding theories are shown. Above is an artist's conception of an aircraft with sweptback flow over most of its surface. A spike on the nose and "canal blades" antennas on the wings and tail create the separated flow and it is maintained by gas tied into the flow from the small

wallies in the skin. Such design theoretically offers one less factor in the equation and reduces skin friction drag to a small fraction of its normal value, thus solving the two primary problems of hypersonic flight. Seymour Englander of Princeton University has proposed such a design method.

Hypersonic Aircraft Will Face Technical.

By J. S. Bels, Jr.

Washington—Hypersonic aircraft, now entering the development stage in the U.S., have two primary and interrelated problems—great technical development cost and soaring costs.

It is, for example, almost impossible to find agreement among hypersonic research scientists as to the ideal configuration for a winged orbital aircraft. A somewhat greater consensus of opinion can be found among engineers faced with the practical problems of planning hardware, such as in the Dyna-Sonic I program, but the present conflicts of engineering opinion can still be compared in many ways to the confused aerodynamic design confusion during World War I and shortly thereafter.

The cost of flying at many times the speed of sound today presents concepts illustrated by the Dyna-Sonic I, which is scheduled to be the first truly hypersonic U.S. research aircraft. This bonafide project is being managed jointly

by the Air Force and the National Aeronautics and Space Administration and is a descendant of the North American X-15 and the X series of rocket-powered research aircraft.

Dyna-Sonic Program

The Dyna-Sonic I flight test program is now planned around the traditional U.S. accelerated research policy of slowly inching toward the maximum performance of research aircraft. Several lines of this policy of progressing into new performance regimes by small increments have been proven in the past since it permits many unexpected trouble areas to be identified and removed before they become critical.

Two features in the Dyna-Sonic program indicate that it will be much longer and much more costly than any of the previous research aircraft programs. They are:

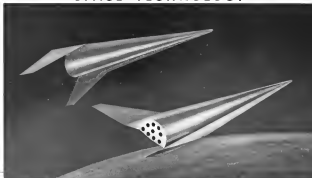
• Large speed range: that the Dyna-Sonic is intended to cover. Final goal of the Dyna-Sonic program is orbital speed of around Mach 24. Actual flight cap-

acity with current aircraft today extends only slightly above Mach 5 in the Bell X-2, and the X-15 is designed to little more than double it. Advancing from Mach 6 to 24 by small speed increments is a series of well thought-out, well planned flights will take time. One decision that will speed the accelerating flight program is to have three aircraft operating at one time. Such a program, planned for five X-15s and probably for five Dyna-Sonic also, should reduce time lost for modifications, repairs, etc.

• Dyna-Sonic will be rocket boosted from the ground which will raise the cost per flight well above that for a research aircraft dropped from a high flying plane. The booster in the Dyna-Sonic program will be in the ICBM category and, unless some reliable method of recovering these is developed so that they can be used more than once, the cost of several hundred flights will be astronomical. Possible recovery techniques already are being studied under the sponsorship of the National Aeronautics

and Space Administration (AW June 1, p. 25).

SPACE TECHNOLOGY



ARROW WINGED hypersonic aircraft shows no suggestion of A. I. Eggers, Jr. of NASA and Walter D. Hayes of Princeton University. The far right Eggers configuration (modified), is designed to bleed flow from interaction shocks. Hayes aircraft (right) with the flat bottom is intended to keep skin friction drag low. Flight

test laboratories probably will be required to prove which design idea is best for any given speed and altitude situation. Streamline high performance, high lift/drag ratio shapes of this type are best suited for fighter half-way around the world down to transcontinental ranges. Blunt shapes are better for global ranges.

Cost Problems

and Space Administration (AW June 1, p. 25).

An additional source of great cost for the Dyna-Sonic program is the materials needed for its construction. Steel, steel, titanium, graphite and many new materials such as carbon-fiber and the revolutionary aerels will be used on the aircraft, and they are expensive. All of these new materials are new in development, and experience is being accumulated on producing and handling them. They have no large-scale market, however, and their production costs remain very high for years. Air Force estimates are that each hand-built copy of the Dyna-Sonic I will exceed \$100 million.

These obvious high costs have brought a recommendation of the entire Dyna-Sonic program. There is considerable opinion both within the government and in industry that a very high cost program should be avoided until the last possible moment. This could be accomplished in part by sticking to research aircraft that are branched from other aircraft until Mach 10 or 12 is reached and



NEW MATERIALS and wing tanks could push X-15 speed to nearly Mach 8. Adding higher performance rocket engines could extend speed to about Mach 15. Launching a Mach 3 booster could then make Mach 17 a possibility. Extending performance of current research aircraft may be one economical method of reaching orbital speed with winged vehicles. Artist's conception above shows the X-15 wing stage configuration which would allow the rocket to burn several seconds longer and increase the maximum speed.